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S. D. KIRKPATRICK, Editor

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# *Ten Thousand More Chemical Engineers For Industry to Absorb!*

BACK in the more prosperous years from 1925 to 1929, industry demanded more chemical engineers than our schools and colleges could supply. Competitive bidding resulted in high salaries, even for beginners. Many youngsters, encouraged by high-school essay contests and other well-meant efforts to sharpen their interest in chemistry, decided to embark on careers in chemical engineering. The result, according to the U. S. Bureau of Education, is that in the school year 1930-31 there were 9,667 students enrolled in chemical engineering—roughly an eighth of the total in all of our engineering colleges. In addition the enrollments in such specialized industrial courses as petroleum technology would undoubtedly add several hundred more to this impressive total of prospective candidates for chemical engineering jobs.

THAT THE PROBLEM of absorbing such an avalanche of recruits is one of real concern to the profession is evidenced by the thoughtful study given it by Prof. A. H. White on behalf of the A. I. Ch. E. committee on chemical engineering education. The results of his questionnaire on the occupations and earnings of more than a thousand recent graduates would seem to indicate a potential demand from industry for approximately two thousand chemical engineering recruits each year. His figures show further that five industries—viz., chemicals, petroleum, rubber, iron and steel, and pulp and paper—account for more than half of the total, while such major fields as food, textiles, and leather are scarcely represented at all. Combined, they amount to less than 2 per cent of the total. "It is perhaps idle," Professor White concludes, "to speculate too much on the future possibilities for chemical engineers, but the figures indicate that the saturation point is still some distance in the future." Certainly this must be the case with those important industries in which there has been but a minor penetration of chemical engineering.

PROGRESS in converting such an industry to a genuine appreciation of science often has its beginning in a project for cooperative research. As this work demonstrates its value, the idea is taken up by the individual companies, and once a live research department is established, chemical engineering developments are sure to follow. A slower and less spectacular way to the same goal is through the gradual infiltration of technically trained men who eventually reach positions of authority and introduce scientific methods and engineering equipment.

FACED with the immediate problem of finding places for as many of the unemployed chemists and chemical engineers as possible, the Unemployment Committee of the New York societies has wisely decided to concentrate its attention on non-chemical industries. In this way some of them may become acquainted with and confident of the value of chemical engineering services. But this local effort is, of course, only a stop-gap. A much more comprehensive educational program must get under way throughout the entire country if we are to build up a sufficient demand on the part of industry to absorb the ten thousand or more chemical engineers that will be graduated from our schools during the next three or four years. Otherwise the profession may soon face a more or less permanent unemployment problem.

# EDITORIALS

DECEMBER, 1931

## Production Becomes Distribution-Minded

CHEMICAL industry has more of a transportation problem than many of its executives have ever realized. This fact is brought squarely home by the Interstate Commerce Commission's recent proposal to the railroads. Raw materials for the process industries alone must carry a full 40 per cent of the $125,000,000 burden which the increased rates would saddle on the shippers. Added to this are the already high tariffs on many finished products so that the industry's total freight bill is an impressive proportion of the nation's total.

Likewise the individual company's freight bill may sometimes be its largest single item of expense. In a certain section of the country, the kraft paper manufacturer, for example, finds that between 35 and 40 per cent of the delivered cost of his product is represented by the cost of bringing in the raw materials—pulpwood, fuel, and chemicals—and shipping out the finished paper.

Believing that the chemical engineer and production executive will profit from a broader knowledge of transportation and related problems of distribution, the editors of *Chem. & Met.* plan to give over the entire January issue to a careful study of these important factors in their relation to the delivered cost of commodities. After all, it is the delivered cost of any product that determines whether or not it can compete successfully.

## Phosphoric Acid At Muscle Shoals?

WHEN the joint commission representing Alabama, Tennessee, the national farm organizations, and the federal government made its preliminary report on Muscle Shoals last month, most observers regarded it as just another of the long series of pros and cons that have plagued the chemical and fertilizer industries and consumed so much of the taxpayers' money during the past decade. Some wag remarked that this particular report did not cost very much and probably was worth it. But that was before the commission had made public all of its studies.

An examination of the various documents supporting the commission's decision reveals some very interesting technological and economic information from which industry as well as Congress may possibly be able to draw some constructive conclusions. The case against governmental operation of the power plants is particularly well presented. Furthermore, after all these years of educational effort it is distinctly encouraging to note the comment that "nitrogen for fertilizer production can be purchased at less than the cost of making it at Muscle Shoals." On the other hand, the commission finds that certain other developments of recent years make it impossible to dismiss the whole fertilizer problem so easily. One of these is the electric-furnace process for producing phosphoric acid; another is a new technique for making concentrated fertilizer; a third is the recognition of the need for more research and experimental practice in adapting these products to the requirements of the farmer.

Perhaps there are some in chemical industry who will question the need for more phosphoric acid production—by electric furnace or any other process. Others, including a few of our agronomical friends, are beginning to lose some of their earlier enthusiasm for the concentrated fertilizer. Despite such criticism, however, we believe that the report as a whole is in the line of progress. It argues for private operation under lease contracts obtained through competitive negotiations. It is the only logical basis for the eventual disposal of Muscle Shoals, assuming, of course, that some day Congress will tire of its favorite toy. Frankly, though, we doubt if that day is very near.

## Needed—Training for the Fire-Prevention Engineer

ALREADY the number of types of "engineers," so-called, has expanded into the hundreds, to the considerable chagrin of those members of the dozen or so professions of true engineering status. But in so urgent a cause as scientific fire prevention and fire fighting, it seems excusable to seek recognition for the need for, and the establishment of, the profession of fire-prevention engineering.

It should not be supposed that fire prevention has been a neglected subject or that agencies do not already exist fully capable of framing well-conceived ordinances for reducing fire hazards. Various official and semi-official bodies have already done a very thorough job of investigating these hazards. None the less, it is a fact that men with the requisite technical training in fire prevention and fighting are not available in number sufficient to meet the demand that ought to exist. If this demand appears slight at present, it is nothing less than a reflection on the civic spirit of the chemical engineering profession.

Every fire, wanted or not, is a phenomenon in applied chemistry. It is true that not every fire, nor its prevention, requires the consultation of a chemical engineer. But for the vast number of special fire hazards that dog our modern footsteps, engineering of a high order —essentially chemical—is a very definite need. What such engineering would involve was well summarized by former Chief Kenlon, of the New York Fire Department, when he recommended some time ago that a four-year course in fire prevention should be included among the curricula of at least one recognized school of engineering. Pointing out that the day has passed when the function of a fireman was solely that of throwing water on a fire, he suggested thorough training in building construction, strength of materials, hydraulics, chemistry, and mathematics. Of these, building construction and a variety of industrial chemistry emphasizing the hazards of flammable materials and their control would seem to have the most bearing on the case.

Probably it is too much to ask that a four-year course be offered in fire-prevention engineering. Surely, however, there must be some happy medium between this ideal and the all-too-brief glimpse into fire-fighting

science that has been offered to firemen once a year by a single middle-western college. Is it too much to ask the chemical engineer to recognize this Frankenstein monster that is so often the offspring of his own hazard-breeding operations? Might it not be possible for some far-seeing chemical engineering department to spread at least six hours a year in fire-prevention engineering over a four-year course? Surely, the suggestion is not unreasonable.

## Fertilizer Association Campaigns for Members

PERHAPS no other trade association dealing with the problems of a single process industry has done as much for its membership as the National Fertilizer Association. Despite times and industrial conditions that would have tried the patience of a Job, this organization has had the support of the principal companies and retained able personnel throughout its roll of officers and committees.

At its last annual meeting the association materially reduced its tonnage assessment for dues. This is but an added reason which makes membership of greater attractiveness to those who have not hitherto participated in the work. Management in the fertilizer industry seeking an opportunity to save from every angle because of the general industrial situation will not be exercising real economy by declining to take part in the valuable work of this organization. We have no doubt but that ultimately N.F.A. will succeed in gaining the cooperation of substantially the whole industry; we hope, however, it will achieve this success at an early date.

## Industrial Classroom For Industrialists

IN THE successful educational enterprise conducted by the Bausch & Lomb Optical Company, Rochester, N. Y., reported in the news pages of this issue, two groups have presumably gained: The "students," because of a widened scientific horizon for both themselves and their employers; and the "teachers," because of a fuller appreciation of their potential services. A limited, invited enrollment of technical representatives from fifteen companies (representing nine chemical industries) has undergone an intensive two-weeks' course to learn from authorities, engaged by the sponsors, the theory and applicability of optical devices. No outlay was involved except personal expenses; the arrangement guaranteed a serious exploitation of the brief opportunity for study and experiment.

Are there not perhaps other production "tools" insufficiently known to the paint, glass, paper, chemicals, textile, food, detergent, metallurgical, refractories industries? The photo-electric cell, of course, suggests itself offhand. Here seems to be another legitimate approach, assuming that it will always be conducted on a seriously educational plane. Naturally this medium, like the technical school and journal, is hopelessly discredited as soon as it succumbs to temporary commercial expediency.

## Are Chemical Engineering Unit Costs Worthwhile?

SHOULD success attend a proposal made on November 30 before the Process Industries Committee of the American Society of Mechanical Engineers, both chemical engineers and mechanical engineers in process plants will possess an enormously valuable tool for purposes of estimation and comparison. Briefly explaining his classification of the unit operations of chemical engineering, Professor H. J. Masson, of New York University, made the suggestion that the committee set about the monumental task of seeking several sorts of average data, based on experience for several or all of the unit operations in the more important process industries in which these operations appear. Space and time required for each operation per ton of product, and unit costs of equipment, labor and power, are typical of the data to be obtained, should the plan be finally approved.

Although it was recognized that the gathering of these data would require several years, and that constant effort would be needed thereafter to keep them up to date, the committee's decision, at least temporarily, favored the proposal. Successfully consummated, the compilation would give a partial cross-section of chemical engineering experience. It would offer a reliable mark for less efficient plants to shoot at, and it would form a very nearly royal road to simplified estimation.

The final decision, however, will be delayed until a subcommittee has had an opportunity to examine the desirability of the project from every angle. Lest the chemical engineer fear that his toes may be tread upon, it should be explained that A.I.Ch.E. representation on the subcommittee will be provided for. Meanwhile, *Chem. & Met.* feels that a frank discussion, in its columns, of the value of unit operation costs and similar data will be of real assistance to the subcommittee in forming its final decision. To this end, opinions of readers are earnestly invited.

## Hollywood Hokum

THE MOVIES seem to have made Hollywood the country's capital of showmanship. The spirit has infected even some of the most prosaic of chemical industries. Take, for instance, the fortified mineral water business. Right off one would think it pretty hard to improve on Chic Sale's indorsement of the famous product of French Lick, Indiana. Yet in the little circular courteously handed to us at our Hollywood breakfast table last summer, we read about a drinking water that is "Juvenile." We wondered what that meant until we followed the asterisk down to the footnote at the bottom of the page, and there learned that "Juvenile drinking water is the geological term for virgin pure water coming from profound depths, wherein nature's Hydrogen rising through miles of granite dissolves with Oxygen, forming naturally pure $H_2O$. This is the deep-seated source of——Spring Water. Being Juvenile, it is fresh, pure, healthful, and better tasting." And so we learn that other things besides gold mines can be "salted" in this land where men are men and women are glad of it!

*So nigh is grandeur to our dust,*
*So near is God to man,*
*When Duty whispers low, Thou must*
*The youth replies, I can.*

—EMERSON

# THEIR UNEMPLOYMENT PROBLEM IS OURS

**AN EDITORIAL**

FUNDAMENTALLY there is so little difference between those of us who have jobs today and our brother engineers who have not, that their plight becomes a very real part of our own existence. Only circumstances—quite beyond their control—have made them less fortunate. The least we can do is to stand shoulder to shoulder with them in the fight to win their battle against such discouraging odds.

Frankly, we have little patience with those who would minimize the seriousness of the unemployment situation in chemical industries. True, there may not be quite as many unemployed chemists and chemical engineers as in some of the older professions, but to say, as has actually been declared, that only 1½ per cent of the membership of the American Chemical Society is out of work, is to refuse to face the facts. Furthermore, the only fair viewpoint today is that of the whole profession, not of any part or group. The simple truth is that unemployment among technical men has reached serious proportions.

Chemists and chemical engineers unemployed for as long as two years, have lost their morale. Many are willing to do anything to live. A research chemist graduated in 1925 from our largest eastern university has lived for the past year in the cellar of the home of one of his former college professors. In eleven months of discouraging search for a job, he has spent the last cent of his meager earnings. Today he wants anything that will give him two meals a day—$20 a month for the next three months. Who will say to him that unemployment is not a serious problem in chemical industries?

## What Is Being Done

Even assuming that business is already on the mend, a condition that is at least debatable, it appears unlikely that the demand for engineers and chemists will increase at a rate sufficient to take up the slack in employment for many months to come. In the meantime, something must be done to save the unfortunate men who are destitute and whose families are facing starvation. A start in this direction has been made, but united support on the part of the industry in general is now imperative.

In several centers throughout the United States movements are under way to alleviate distress among technical men. In the New York metropolitan area, local sections of A.S.M.E., A.I.E.E., A.S.C.E., and A.I.M.E. established the Professional Engineers' Committee on Unemployment. The splendid example of the founder engineering societies has been followed by the group of chemical organizations, headed by the New York Section of the American Chemical Society and supported by the American Institute of Chemical Engineers, the Electrochemical Society, Society of Chemical Industry, American Institute of Chemists, Association of Consulting Chemists and Chemical Engineers, and Société de Chimie Industrielle.

The sponsoring societies have approved an honorary unemployment committee composed of Francis P. Garvan, Leo H. Baekeland, Horace Bowker, Charles Herty, D. D. Jackson, Maximilian Toch, and William J. Schieffelin, who have promised their support. A hand-picked active canvassing committee headed by Col. T. H. Murphy has been selected from among the unemployed chemical engineers and chemists. And Frank G. Breyer has been appointed liaison officer between societies and committees.

The canvassing committee is registering the unemployed, but its more important duty is the thorough canvassing of industrial firms in the metropolitan New York district—other than chemical—that might possibly benefit by the services of a chemical engineer or chemist. Jobs that are found will be filled by the committee from the applications on file in its office, or at the bureau of employment operated for the benefit of the

profession by the Chemists' Club. The miscellaneous expenses of the working committee are covered by a fund contributed by sponsoring societies.

At the request of the Professional Engineers' Committee on Unemployment, Columbia University has announced, through Dean J. W. Barker, that classes in the engineering department have been opened to unemployed professional engineers. The number of engineers admitted will be limited only by the size of the lecture halls. Applicants must secure a certificate from the engineers' committee showing that they are accredited members of the profession and that they are idle through no fault of their own. As Dean Barker explains:

> The principal purpose for opening the classes without fee or credit to the engineers is to preserve the morale of these skilled men during a period of enforced idleness.

Somewhat similar relief work is being done in many other sections of this country. In northern New Jersey the local section of the A.C.S., under the leadership of Chairman George M. Maverick, has an active committee composed of unemployed men. Those in search of positions are given a card of introduction to prospective employers showing that the applicant has paid his dues to the society. The membership has been sent a questionnaire calling attention to openings in their plants or elsewhere.

In Louisiana a bureau of employment has been inaugurated to assist the unemployed. Questionnaires have been sent those out of work requesting information dealing with their education and experience. This information is available to employers. Advertisements are being inserted in the daily papers advising employers of this employment service. The operation of the bureau will be paid for by the local section of the A.C.S.

## What's Yet to Be Done

The schemes for unemployment relief that are being carried out in one section of the country should seriously be considered for their adaptability in the other localities. Just as Columbia University in New York City has opened its classes to men out of work, so might the great universities and colleges of Chicago, Philadelphia, New Orleans, and other cities open theirs. Likewise the advertising program of the Louisiana chemists is worth a tryout in New York and Chicago.

Furthermore, having applied to the utmost these commendable ideas, we should not be content to stop here. There must be many other plans that would at least assist in this humanitarian work. Process industries in general should increase the number employed without increasing the payroll by reducing working hours per individual per day, or by rotation of employment. Chemical societies might interest industrial concerns by putting into effect such a program as was recently initiated by an electrical equipment manufacturer who promised to donate 2 per cent of gross sales from November to March, inclusive, to relief organizations. Local sections of the societies could establish relief funds for the purpose of assisting financially those men in distress by canvassing all employed chemical engineers and chemists, irrespective of memberships, for a small percentage of their salaries for the next four or five months.

Although our urgent immediate problem is that of relieving the distress of those out of employment and in need of assistance, we must not lose sight of the fundamental problem of providing a permanent solution to unemployment. When normalcy returns it will be only natural to forget the probability of another industrial depression; it is imperative that we avoid a repetition. Concerted action must be made to develop a plan, whether it be a Rochester or a Swope plan, or insurance, that will temper the evils caused by the recurring periods of low employment still unfortunately a concomitant of industrial activity.

In the face of the inseparable interdependence of all industries and business enterprise, a view to long-time stability would especially recommend a general plan as comprehensive in scope as a national unemployment-insurance movement, initiated most feasibly by industry's leaders and larger associations. Socialistic as it may seem to some, it is nevertheless only a method of enforcing the thrift and frugality which made our pioneer forefathers sufficient unto themselves, but which, in less heroic days, seem to have deserted our people.

**Principals in Relief Among Chemical Engineers and Chemists in New York Area**

*Blank & Stoller*

**Left to right: Col. T. H. Murphy, chairman active committee; Dr. C. R. Downs, chairman of committee directing Chemists' Club employment bureau; and Frank G. Breyer, executive secretary of unemployment committee**

In a period of severe depression, modernization is worth while even though capital expenditures are necessary because equipment may be installed at much lower costs than in normal times and returns which may eventually be expected will be much higher.

# Modernizing a Petroleum Refinery

By J. M. EVANS
*Manager Sales Engineering and Development*

and L. H. SHARP
*Research and Development Department*
*Associated Oil Co.*

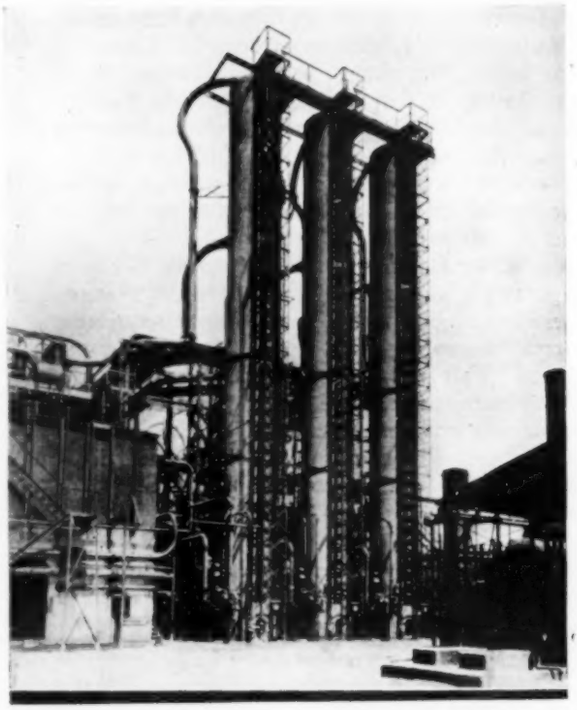
WITH the recent period of overproduction of crude petroleum, the bonanza days in refining appear to have passed. Thousands of small refineries have sprung up and new petroleum products are appearing on the market every day. The number of service-station outlets has increased tremendously and competition for the business of the motorist has become keener.

Diversification of products and serious price wars have resulted from this increased competition. Many independent refiners, having entered the petroleum business at the peak of crude production, are content to operate on a relatively small scale at minimum overhead in metropolitan areas. Such a situation, naturally, has made it difficult for the major refiner to compete profitably.

The large oil company has a tremendous investment in equipment and is making continuous expenditures in research and development work, looking to the future of its industry. Such outlays are not a part of the marketing plan of the small independent. In viewing the present situation and in looking ahead to future possibilities, the major established refiner must keep in mind the possibility of improving his present position. To accomplish this, there are three lines of attack.

First, he must insure continued improvement in the quality of his products, which determines the proportion of the business which he obtains over competition at equal or lower prices. Therefore, in times like the present, his research and development work should be concentrated on the improvement of present products and their production at lower costs.

The second factor which the large oil company must watch more closely today is overhead expense. This is true in every department of the petroleum industry. Naturally, prospecting for new oil fields must be curtailed and costs of drilling and producing must be reduced to a minimum. Manufacturing operations must be so handled that greater throughputs can be obtained with reduced man power. Coordination of efforts to insure minimum slack in any department must be constantly watched, and the sales department has its work cut out for it in lowering overhead costs. Rerouting of deliveries may be a means of effecting major savings; uneconomical deliveries must be kept at a minimum. The featuring of various products for a variety of uses and the introduction of current lines of oils and greases into new industrial functions will assist in preventing a multiplicity of products.



**Throughput of 45,000 Bbl. Per Day to Finished Distillates Is Handled by Modern 92-ft. Fractionating Towers**

The third main adjustment which can be made by the petroleum industry is reduction of direct cost. This is especially true in refining operations, where modern types of equipment permit increased production at lower labor and fuel costs. At the present time, a refinery, in considering the possibilities of modernizing its operations, can make up a balance sheet in which the justification for new equipment is carefully analyzed. This is partly due to the fact that many equipment manufacturers are willing to make installations on the basis of performance

**Avon Refinery Is an Example of What Can Be Done to Modernize a Plant and Make the Investment Pay a Profit**

guarantees. In making such a justification for installation of new equipment, one of the primary considerations is quality. We have already pointed out that continuously improved quality is one of the chief means by which the major oil company can maintain its position in a highly competitive field. On careful examination it will be found that nearly every product which is sold has some particular feature or characteristic which is subject to improvement by a change in manufacturing operations. Even if such improvement in quality cannot be considered revolutionary, it is a certainty that to be in the foreground with every product, as far as quality is concerned, will in the long run insure markets.

Over-all operating costs should next be considered in the justification for new equipment. One of the first considerations under operating costs is the possibility of increased yields. For example, it will be found that with the use of modern high-capacity fractionating equipment a marked increase in yield of any given distillation range can be obtained over and above the yield which is obtained by redistillation in equipment which is not provided with proper fractionating facilities. In the distillation of 50,000 bbl. of crude oil per day, increasing the yield from 25 per cent of gasoline to 27 per cent means an increased recovery of a thousand barrels of gasoline per day. The financial benefit of such increased recovery can easily be calculated. It will be found that most new refining equipment is so designed that many of the operations are automatic or at least semi-automatic. This means that labor charges can be materially reduced. It will be found that in almost any modernized plant, the throughput has been increased from two to three times, although labor has been reduced.

Another great advantage of modern equipment which assists in the balance-sheet justification is the reduction in fuel charges. As an example, formerly the cost of manufacturing gasoline was in large part directly chargeable to the high fuel rate. In modern equipment the use of proper heat-exchange and heat-transfer processes has cut the cost of fuel from one-half to two-thirds. A further saving that can be estimated and credited to the installation of new equipment is in reduced costs of treating, particularly the chemical cost. Many methods have been developed in recent years for insuring complete removal of undesirable materials at much lower operating costs. Many inefficiencies in treatment can be traced to the original distillation equipment; and in every case where modern distillation equipment has been installed, a marked saving has become immediately noticeable in the costs of finishing all the distillates produced from this operation.

In addition to the increased yield from a given throughput most modern refining systems permit increased throughputs with the same sized equipment and—a most notable factor—the use of continuous methods as opposed to the batch system. Better facilities for handling oil to and from any operation and improved methods of heat transfer permitting more rapid distillation operate to increase the throughput. Other types of equipment may often be justified by the fact that they permit the recovery of valuable materials which formerly were lost. Such equipment may make possible an increased market value for products previously sold at lower prices. An instance of this would be the installation of equipment for the manufacture of road oils from material formerly sold as fuel.

As definite examples of what can be done to modernize an oil refinery and make this investment pay a profit, the work done by the Associated Oil Co. in the last few years in its manufacturing operations may be cited. The plant of this company located at Avon, Calif., on upper San Francisco Bay, has been largely rebuilt within the last eight years and is now one of the most up-to-date plants on the Pacific Coast. Its rated capacity is 60,000 bbl. of light crude oil per day, plus cracking capacity of 10,000 bbl. of charging stock, and an additional capacity of 4,000 bbl. of heavy crude oil for manufacture of lubricating stocks. The plant manufactures practically

all petroleum products except wax, vaseline, and air-blown asphalts.

The introduction of fractionation into the petroleum industry has been rather recent, considering the length of time that the value of careful fractionation has been known to other distilling industries. One of the first steps in modernization, therefore, was the installation of a light-oil distillation plant. Formerly, crude oil was distilled in several batteries of shell stills with a sufficient number of redistillations to obtain the requisite boiling ranges of the finished products. We find that 33 stills and 8 toppers have been replaced by 7 stills which are handling a considerably larger throughput. Fractionation is accomplished principally in three bubble towers, each of which is 92 ft. in height.

In order to make use of a part of the equipment which was already on hand, several large shell stills were equipped with internal forced oil circulation to increase the heat-transfer rate through the shell bottoms. The fireboxes are air-cooled and this heated air is used to supply Peabody burners operating under forced draft to give maximum turbulence to the products of combustion. Heat exchange with the high-temperature vapors and the outgoing fuel insures the greatest economy in this direction and is used to flash the water and light gasoline in the Badger bubble towers before the crude actually enters the fire stills. Later the flue gases from this battery of stills are led through a pipe-still economizer and a small tube furnace which acts to smooth out any irregularities of heat exchange.

### Lubricating Oil Plant Modernized

Preliminary chemical treatment is used in the towers both as a protection to the equipment itself and as a means of reducing the amount of chemical treatment needed later. The treating operations are so conducted that gasoline is fully finished in its direct flow from distillation unit to finished storage, which results in great economy of labor and chemicals. This equipment was installed on the basis of a financial justification prepared prior to installation. Results have shown that the installation has fully paid the profit indicated by these calculations. We have found all the factors which are essential to the justification of this type of equipment: improved quality, increased yields, reduced labor and fuel charges, reduced chemical costs, and increased throughputs.

One of the most recent improvements is the modernization of the lubricating-oil plant. This plant now has sufficient new equipment to handle 5,000 bbl. per day of lubricating oil which is piped while hot and flashed in a Badger vacuum bubble tower, where it is fractionated into close-cut lubricating distillates. This unit has justified itself because of its ability to make high-quality lubricating oils to specifications with a minimum of chemical treatment and without the necessity of redistillation or blending. The unit was one of the first in the Associated refinery in which an attempt was made to centralize all instruments in a special control room so that the entire operation could be under guidance of a single operator. Lubricating distillates from this unit are treated by the Edeleanu process for the production of Cycol motor oils. This treating process, which makes use of liquid sulphur dioxide as a treating agent, is applied also to kerosenes and transformer oils. The Edeleanu plant may be considered as equipment which was installed mainly because of its ability to produce improved qualities.

A new cracking plant of modified tube and tank design with Badger towers and fractionating equipment has been the most recent installation. This plant started operation in July, 1931. It is equipped with two furnaces, one of which is designed for a viscosity breaker and the other for a cracking furnace. The viscosity breaker is capable of handling 10,000 bbl. of fuel oil per day, producing a small yield of gasoline and a large yield of gas oil which becomes the charging stock for the cracking furnace. The operation through the cracking furnace is modern; the gas oil passes through the cracking tubes to reaction chambers which are continuously drained of liquid and hence contain only dense vapor. The fractionating equipment is operated under relatively low pressure after the release from the reaction chambers.

### Justification of New Equipment

The most modern equipment for handling high-pressure operations and for finishing the pressure distillate has been installed. The pressure distillate is stabilized, treated, and then redistilled in a combination atmospheric and fractionating vacuum unit which insures the highest quality of cracked gasoline having good color stability and odor, and low gum and sulphur. This unit is provided also with a central control room which permits operation with the minimum amount of labor, since it is possible for the operator to control distillation temperatures, throughput, and all other operations from this central board.

The justification of such a cracking unit must take into account a prediction on future market conditions covering the spread between the price of fuel oil and the price of gasoline. The advance in the art of cracking heavy oils permits such calculations, since equipment manufacturers can now guarantee the performance of such a unit with respect to its throughput, gasoline yield, steam and fuel requirements, and operation losses.

The same type of modernizing program has been carried through to the blending, compounding, and manufacturing of finished products, as well as their packaging and shipment, and it is indeed surprising how many places can be found in any refinery where savings can be made not only without sacrifice of quality but often with an improvement in quality.

### Byproduct and Waste Recovery

Among recent installations which have been made for the purpose of byproduct and waste recovery may be mentioned the vapor-recovery plant which was installed to collect the still and tank vapors in order to recover any gasoline-producing materials which formerly went to waste in the lost vapors. This plant is one which required considerable investigation and calculation in order to find its justification. It has been surprising to note how closely its gasoline recovery has checked the original estimates on which its installation was based. Progress has been made in increasing the value of many of the byproducts which were formerly wastes. Many minor installations have done much to increase the price which was formerly obtained on low-grade products by placing them in a classification where they would command a better market.

Several of the installations mentioned above have been made within the last year or more, during a period which is generally spoken of as a severe depression. The Associated Oil Co. has felt that a far-sighted policy in this respect would be valuable in the long run because of the fact that this is the period when it is essential that the utmost be done to increase returns.

# A. I. Ch. E. Holds Lively Sessions at Atlantic City

EDITORIAL STAFF REPORT

STREAM POLLUTION, occupations and earnings of chemical engineering graduates, and the highly controversial issue of platinum vs. vanadium catalysts for sulphuric-acid manufacture formed the basis for three intensely interesting discussions at the twenty-fourth annual meeting of the American Institute of Chemical Engineers, held Dec. 9-11, at Atlantic City, N. J. Albert E. Marshall, who served as chairman of the committee on papers, presided at the timely symposium on stream pollution and the treatment of industrial wastes. He showed how these problems had become increasingly important to the chemical engineer.

Robert Spurr Weston, consulting engineer, of Boston, had titled his paper "The Use, Not the Abuse, of Streams." He showed how sanitary engineering problems come about as a result of the concentration and centralization of population in congested areas. Each stream and river, he said, has a definite capacity for self-purification by absorbing the oxygen contained in the air and thus oxidizing, to a certain extent, the putrescible organic matter contained in it. This capacity for natural purification is dependent upon dissolved oxygen present, the natural re-aeration that takes place, the geography of the watershed, the biological conditions in the stream and, finally, the available time of transit.

In Pennsylvania, according to W. L. Stevenson, chief engineer of the Department of Health, cooperation has been the keynote in the solution of stream pollution problems. Constructive results are quickly and peacefully attained when engineers and chemists representing conflicting interests sit down at a conference table, pool their diversified knowledge of the scientific and economic aspects of the problem, and earnestly seek to find a reasonable and practical solution. Eight years' experience with this so-called "Pennsylvania method" has shown it to be a remarkably successful procedure.

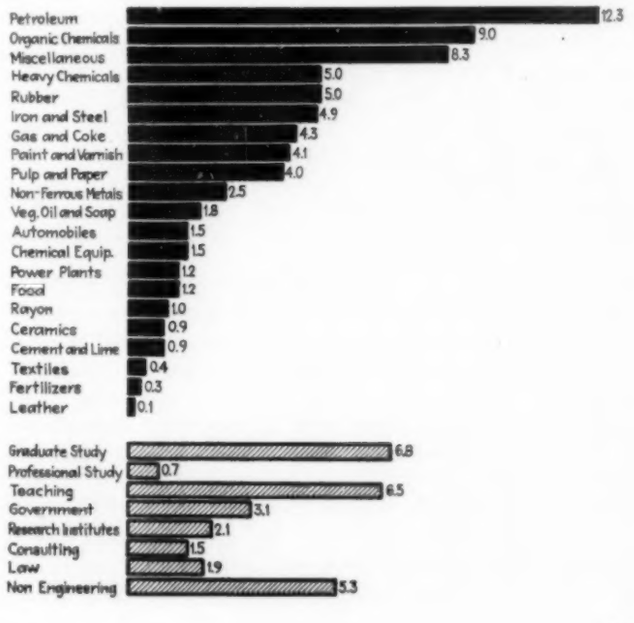
Speaking of the work of the Connecticut State Water Commission, William B. Wise stressed the point that the pollution of waterways is an economic problem to be dealt with as such. A satisfactory method of treating all industrial wastes in a manner to yield a profit to the manufacturer is out of the question and therefore the offender must recognize clearly his responsibility in protecting the rights of the public in the state waterways. The law creating the Connecticut commission stipulated that in its orders to correct pollution it must prescribe ways and means by which the desired results may be obtained. This immediately opened up a wide field of chemical engineering research.

Dr. William Rudolfs, chief of the Department of Water Supplies and Sewage Research at the New Jersey Agricultural Experiment Station, New Brunswick, N. J., has for years been active in matters pertaining to the prevention of stream pollution in his state. In his paper on this subject, he pointed out that 35 per cent of the population of New Jersey are served by sewer systems which discharge untreated sewage into the watercourses of the state, while the sewage from not more than 2,000,000 persons is treated wholly or partially before discharge. Added to this great volume of municipal sewage is the great volume of industrial wastes, totaling 200,000,000 gal. daily, only a small portion of which is treated. Dry solids discharged into the rivers of the state each year amount to 45,000 long tons, according to the calculations of Dr. Rudolfs, and in order to purify the wastes by natural methods, the streams must supply 750,000 lb. of oxygen daily.

Prof. Thorndike Saville, of the University of North Carolina, who also serves as chief engineer for the Department of Conservation and Development of his state, enumerated and analyzed the powers granted the federal government and state governments for the regulation of stream pollution. Federal powers, he stated, related chiefly to pollution problems arising under treaties, interstate commerce, or in connection with the administration of the public domain and with taxation and public welfare. Where the federal government's powers are indirect, the states' powers are direct and, backed by the enforcing powers of the police, are virtually unbounded in scope. Therefore it is to the states that one must look for a better control of pollution.

The disposal of wastes formed in the manufacture of starch and beet sugar was competently discussed by Prof. Edward Bartow, head of the department of chemical engineering, University of Iowa, who for several years has been concerned in a consultative capacity with the problems of these industries. Early day starch factories recovered only the starch from the corn, amounting to perhaps half of the total, but today, with byproduct utilization an accomplished fact, the yield of corn products has increased to 95 per cent. A few years ago the remaining 5 per cent, discharged to the streams as an industrial waste, became the cause of serious complaint from cities and property owners on Lake Michigan, the Illinois River, the Cedar River of Iowa, and the Mississippi River. Cooperative research by the Corn Products Refining Co. and the Sanitary District of Chicago, coupled with investigations at the starch factory of Penick & Ford, not only did away with the pollution but made possible the recovery of a large quantity of gluten and starch which was formerly wasted. In one case 87 to 91 per cent of the waste matter was recovered,

**Percentage Distribution of Chemical Engineering Graduates by Industries, 1930**



and now, by using the corn hulls, oils, and even the water in which the corn is steeped, there should generally be more than 99 per cent recovery of the dry substances in the original corn.

The final paper on the program, "Liquid Wastes From Industrial Plants and Their Treatment," by E. B. Besselievre and Anthony Anable, engineers of the Dorr Co., of New York City, summed up the experience of the authors in the actual treatment of wastes referred to in the preceding papers. They stated that with only a few exceptions the numerous liquid wastes of industry responded to chemical treatment and that problems of this type fell within the sphere of chemical engineering.

Prof. Albert B. Newman, of Cooper Union, New York City, presided at a symposium on Dec. 10 in which four important papers on heat technology were presented and discussed. Three of these came from the research laboratory of the Massachusetts Institute of Technology. Prof. Thomas A. Sherwood, of that school, in collaboration with D. D. Kiley and G. E. Mangsten, of Worcester Polytechnic Institute, has studied the effect of tube length on heat transmission to oil flowing in pipes. A second paper by Prof. Sherwood dealt with the application of theoretical diffusion equations to the drying of solids. In a somewhat related discussion of heat transfer in stream-line flow, Thomas B. Drew, instructor in chemical engineering at Massachusetts Institute of Technology, reported on some recent experiments with glycerin.

What becomes of our chemical engineering graduates? What is the financial measure of their success? To answer these questions Prof. Alfred H. White, of the University of Michigan, studied the results of an institute questionnaire returned by 1,112 graduates of five typical institutions: Michigan, Massachusetts Institute of Technology, Brooklyn Polytechnic Institute, Ohio State, and Minnesota. Certain of his data are presented in the accompanying tabulations and chart.

In a seventh of a series of contributions on zirconium, Henry L. Coles, chemical engineer, of Hamilton, Ohio, and Prof. James R. Withrow, of Ohio State University, reported certain preliminary studies of the corrosion resistance of zirconium alloys. By the use of the total immersion test, they make comparable trials of zirconium and other corrosion-resisting metals and find that the former offer possible uses for resistance to hydrochloric and sulphuric acids. The best alloy for this purpose was: Zr 2.7, Fe 12.03, Ni 71.41, Al 0.32, Si 9.15, and C 0.35 per cent. Zirconium steels may also find use for resistance to caustic soda solutions or to mixed acids.

Most discussion was evoked by Dr. A. Paul Thompson's paper, "Platinum vs. Vanadium Pentoxide as Catalysts for Sulphuric Acid Manufacture," which is published on pages 705-9 of this issue. Andrew M. Fairlie, of Atlanta, in a written communication, expressed the view that vanadium had received much of the credit for low costs which were really due to brimstone and to the use of improved equipment and operation methods. A. E. Marshall, Ellery L. Wilson, and others emphasized the fact that the author's data on the vanadium mass were based on information which the sponsors of the process furnish to prospective purchasers and were, therefore, too conservative. Daniel S. Dinsmoor, of the Merrimac Chemical Co., supported this view by stating that at his plant, working with 9 per cent $SO_2$ in the burner gas, only 3.99 cu.ft. of catalyst was used per daily ton of 100 per cent acid, and the conversion rate was over 95 per cent (Cf. Table I, p. 706). Further, that the space velocity he obtains is 1,065 cu.ft. of gas per hour per cubic foot of catalyst and that 7.09 lb. of S is converted to $SO_3$ per hour per cubic foot of catalyst on a 100 per cent basis, or 6.74 lb. on the basis of conversion actually achieved (Cf. Table II, p. 707).

J. H. Shapleigh, of the Hercules Powder Co., explaining that he held no brief for either catalyst, nevertheless regretted the fact that the study had not been made on the basis of laboratory data for which exactly comparable conditions could be maintained. The same view was emphasized in a written communication from Dr. J. H. Perry of the du Pont company, who also inquired if there are any data to prove that the silica gel catalyst is not poisoned by arsenic. E. B. Miller, of the Davison Chemical Co., stated that after five years' operation in his company's plant on Spanish pyrites, no appreciable poisoning has been noted, although laboratory tests often show as high as 1 per cent of arsenic in the catalyst. Others contributing to the discussion included W. H. De Blois, of Canadian Industries, Ltd.; Paul D. Merica, of the International Nickel Co.; J. L. Bennett, of Hercules; and Fred. C. Zeisberg, of du Pont. It is hoped that all of this discussion can be summarized in greater detail in a subsequent issue of *Chem. & Met.* An account of the annual business session will be found in the news section of this issue.

**Type of Employment of Chemical Engineers Receiving the First Degree in Engineering 1920-1930 Inclusive**

| Year after. B.S. | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| Number of men..... | 771 | 705 | 630 | 567 | 498 | 431 | 352 | 288 | 195 | 120 |
| Percentage in | | | | | | | | | | |
| Graduate study..... | 34.2 | 14.5 | 10.8 | 7.6 | 3.3 | 3.2 | 2.0 | 1.0 | 1.5 | 1.2 |
| Teaching..... | 5.2 | 6.0 | 6.0 | 6.5 | 7.3 | 7.6 | 9.4 | 10.9 | 9.2 | 10.8 |
| Analytical lab..... | 16.5 | 14.2 | 11.4 | 7.6 | 5.9 | 4.5 | 4.7 | 3.5 | 3.8 | 4.6 |
| Research lab..... | 12.6 | 18.6 | 18.1 | 17.5 | 19.9 | 18.7 | 16.8 | 15.8 | 16.1 | 19.2 |
| Semi-plant devel.... | 7.1 | 13.6 | 13.7 | 13.7 | 12.4 | 10.4 | 9.2 | 7.5 | 7.4 | 7.5 |
| Plant operation..... | 13.5 | 17.9 | 20.5 | 22.5 | 22.4 | 22.0 | 20.4 | 21.0 | 20.0 | 22.1 |
| Gen. engineering.... | 4.9 | 6.1 | 6.8 | 8.8 | 8.3 | 8.1 | 10.5 | 9.4 | 11.5 | 11.7 |
| Sales..... | 1.8 | 3.0 | 5.2 | 6.8 | 9.5 | 12.4 | 13.8 | 15.5 | 14.9 | 13.7 |
| Miscellaneous..... | 4.2 | 6.1 | 7.5 | 9.1 | 10.8 | 13.0 | 13.2 | 15.5 | 15.4 | 9.2 |

From "Occupations and Earnings of Chemical Engineering Graduates" by Alfred H. White.

**Salaries of Chemical Engineers According to Type of Employment**

Data from Graduates receiving their first degree in Engineering, 1920–1930

A. Median B. Lower Limit of Upper Quartile

| Years After First Degree | Teaching | | Analytical Lab. | | Research Lab. | | Semi-Plant Development | | Plant Operation | | Genera Engineering | | Sales | | All Groups | | Total Individual[a] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | A | B | A | B | A | B | A | B | A | B | A | B | A | B | A | B | |
| 1 | 1,500 | 1,800 | 1,600 | 1,800 | 1,800 | 1,800 | 1,800 | 2,000 | 1,800 | 1,800 | 1,800 | 1,800 | 1,800 | 1,800 | 1,800 | 1,800 | 417 |
| 2 | 1,600 | 1,900 | 1,800 | 2,000 | 2,000 | 2,400 | 2,000 | 2,400 | 1,900 | 2,200 | 1,800 | 2,100 | 2,200 | 2,500 | 1,900 | 2,200 | 493 |
| 3 | 1,800 | 2,100 | 2,000 | 2,200 | 2,200 | 2,700 | 2,300 | 2,600 | 2,300 | 2,700 | 2,400 | 2,600 | 2,400 | 2,700 | 2,200 | 2,500 | 455 |
| 4 | 1,900 | 2,400 | 2,100 | 2,500 | 2,500 | 3,000 | 2,400 | 2,800 | 2,500 | 3,000 | 2,700 | 3,000 | 3,000 | 3,300 | 2,400 | 2,900 | 413 |
| 5 | 2,100 | 2,600 | 2,400 | 2,700 | 2,700 | 3,200 | 2,800 | 3,300 | 2,800 | 3,300 | 3,100 | 3,600 | 3,300 | 4,200 | 2,700 | 3,300 | 382 |
| 6 | 2,400 | 2,600 | 2,600 | 2,900 | 3,200 | 3,600 | 3,000 | 3,700 | 3,200 | 3,400 | 3,400 | 3,700 | 3,600 | 4,500 | 3,000 | 3,600 | 317 |
| 7 | 2,700 | 2,800 | 2,900 | 3,100 | 3,300 | 4,000 | 3,300 | 3,600 | 3,300 | 4,400 | 3,600 | 4,200 | 4,100 | 5,400 | 3,300 | 3,900 | 255 |
| 8 | 2,800 | 3,000 | 3,300 | 3,600 | 3,600 | 4,000 | 3,400 | 3,600 | 3,900 | 4,500 | 3,800 | 4,600 | 4,600 | 5,400 | 3,600 | 4,200 | 202 |
| 9 | 3,000 | 3,200 | 3,300 | 3,600 | 3,900 | 5,000 | 3,600 | 4,500 | 4,100 | 5,000 | 3,600 | 4,800 | 5,000 | 7,000 | 3,900 | 4,800 | 135 |
| 10 | 3,200 | 3,700 | 3,000 | 4,500 | 3,800 | 5,400 | 3,400 | 4,000 | 4,000 | 4,500 | 4,100 | 7,000 | 5,500 | 7,200 | 4,100 | 5,000 | 101 |

From "Occupations and Earnings of Chemical Engineering Graduates," by Alfred H. White.

# *International Coal Conference Program Centered on*

# Processing and Use of Coal

By R. S. McBRIDE
*Editorial Representative, Chem. & Met.*

PROCESSING and burning of coal received much more attention than did coal production at the Third International Conference on Bituminous Coal, held Nov. 16 to 19, at Carnegie Institute of Technology, Pittsburgh, Pa. Apparently about 80 per cent of the 1,250 registered were interested from the standpoint of gas, coke, and chemical engineering, or as power-plant or industrial-plant users of coal. The same ratio apparently applied also to the large registration of distinguished foreign delegates and representatives of municipalities, states, and technical societies of the United States. The technical papers and discussion, therefore, were of much greater value to the readers of *Chem. & Met.* than might be expected from the title designating the conference.

Problems of coal production, of course, were not neglected. C. E. Bockus, president of National Coal Association, presented the problems which have led to excess productive capacity of bituminous mines. These problems have received extended study and 50 different plans for correcting the troubles of the industry were presented in a chart and discussed by Dr. L. E. Young, vice-president of the Pittsburgh Coal Co. But the conference as a whole failed to offer any new remedy, or even palliative, and the committee reported at the close of the sessions that it had been unable to agree on any proposal. Virtually its findings were, therefore, merely additional suggestions of the individual committeemen.

Competition between fuels, one of the basic causes of the coal producers' troubles, received critical attention from a variety of points of view. Competition within the coal industry itself was also statistically interpreted from an economic point of view in an extended analysis made by Alfred G. White, of the research division of National Industrial Conference Board. Even his analysis demonstrated, however, that it was essentially the competition between coal and other sources of energy which was the more serious of the two competitive problems.

Future possibilities of bituminous coal in the United States were discussed from the standpoint of the eminent industrialist by William A. Forbes, assistant to the president of United States Steel Corp. Mr. Forbes' critical analysis was summarized by him with a forecast visualizing further extension of bituminous coal through three types of utilization: (1) Increased installations of coke and gas ovens making both metallurgical and domestic solid fuel, with special stress on the need for research on and development of additional byproducts; (2) largely increased centralization of power-generating stations with more efficient operation and wider distribution of power; and (3) the development of gas-producer design and efficient operation so that the gas made may compete with and probably even supplant large quantities of fuel oil and natural gas, thus reserving to the coal man more of the ultimate fuel market.

Economic relationships between water power and steam power were analyzed, with engineering estimates typical of United States conditions, by George A. Orrok, consulting engineer, of New York City, who demonstrated why coal power, with its much lower capital cost per unit of output, had so great an advantage over hydroelectric power, except when the latter could be used at very high load factors. Forecasting further economies from the use of higher pressure, higher temperature, and the application of some other medium than water, this engineer contemplates even better economies than the best plants of today.

GAS AND OIL as successful competitors of bituminous coal received much attention. W. T. Thom, of Princeton University, on the basis of a careful analysis of the reserves available, forecasts a more than adequate supply of both petroleum and natural gas to last "beyond the lifetime of the present generation—that is to say, beyond that period for which prediction can be made." Although thus implying no early recession in the successful competition of fluid fuels, he concludes that "conditions [for coal] are bad, but they are not hopeless." His only specific remedy, however, is a proration of coal production so that some of the coal industry may be revived.

The relative costs for transportation of gas and coal from point of origin to point of use determine in large measure which is to be used, according to George I. Rhodes, vice-president of Ford, Bacon & Davis. According to this engineer, the production cost in the field of natural gas equivalent to a ton of coal is from 60c. to $5. In a very large part of the country production cost is 75c. per equivalent to a ton of coal. Hence the transportation charge will determine the cost to the user.

Typical figures in his analysis, as presented in the accompanying chart, contrast former transmission practice with gas operated at comparatively low pressures and with comparatively high unit-cost lines. It will be seen that for distances of transport under 300 miles, coal by railroad has a definite advantage as compared with this former method of gas handling. Modern practice actually realized in the field, though labeled "future" by Mr. Rhodes, is for all distances substantially less expensive than rail transportation. From this fact, Mr. Rhodes concludes that where gas has a comparatively short haul it can almost always successfully compete with

coal up to the amount of supply available. He points out, however, that during the past decade the decline in consumption of coal, compared with former trends, has been more the result of increased efficiency in use of coal than because of developed natural gas and oil. He implies that the same condition will, for the United States as a whole, continue to be true during the next decade.

A somewhat similar analysis of cost of transporting coal in pulverized form in pipe lines—of course, limited to short distances—was presented by Friederich Schulte, director of the Association of Supervisors of the Power Industries of the Ruhr District, Germany. Mr. Schulte also gave a less complete analysis of the costs of transporting powdered coal in railway tank cars.

USER PROBLEMS which affect the competition between gas and coal were presented effectively by R. B. Harper, vice-president in charge of research and testing of the Peoples Gas Light & Coke Co., Chicago. Mr. Harper brought out the fact that in the 50 years from 1880 to 1930 the consumption of all kinds of energy in the United States had multiplied nearly sixfold. During this period the consumption of anthracite has increased only 1.4 times, thus materially offsetting by its decline the large increase in use of bituminous coal. The total coal consumption has increased 6.2 times. In contrast with this, the use of natural gas on an energy basis has multiplied more than 20,000 times; water power, 265 times; and petroleum usage, 43 times.

In his analysis by classes of use, Mr. Harper regards gas—particularly natural gas—as most highly competitive in the case of household, general manufacturing, electric utility, and metallurgical industry activity. He recognizes that in the case of over 40 per cent of the consumption of bituminous coal—for mine fuel, railway fuel, coke ovens, and steamship bunker use—natural gas is not competitive. In a quantitative analysis, presented in the accompanying table, Mr. Harper estimates that of the fuel consumption in 1930 about 34 per cent represents applications of natural gas, fuel oil, water power, and other energy sources supplanting bituminous coal.

Fundamental investigations bearing on a wide variety of fuel subjects were presented, including papers discussing the origin and constitution of coal, proper systems of classification, the fundamental structure and tests for identification of the major constituents of coal, and methods for flotation and preparation. These studies were presented from the standpoint of pure science, in their bearing on the behavior of coal during processing for coke, gas, and other products, and from the standpoint of the power-plant user. Burning of coal in a pulverized form also was discussed in several of the important sessions. Fundamental mathematical and physico-chemical studies on the mechanism of combustion of a solid particle, both with and without destructive distillation, were presented; and the means for pulverizing and the proper design of burners and furnaces for burning powdered coal were given their full share of attention.

Lack of space prevents even a brief review in these pages of these valuable papers. Most of the contributions have, however, been preprinted by Carnegie Tech. and may be obtained on application to the secretary of the conference. It is promised that the full volume of proceedings will be available early in 1932, affording then not only papers but oral discussion at the various sessions. At this point it suffices to say that the general import of the conference discussions was clearly an indication of a tremendous increase in the quantity of coal that would be utilized in powdered rather than lump form.

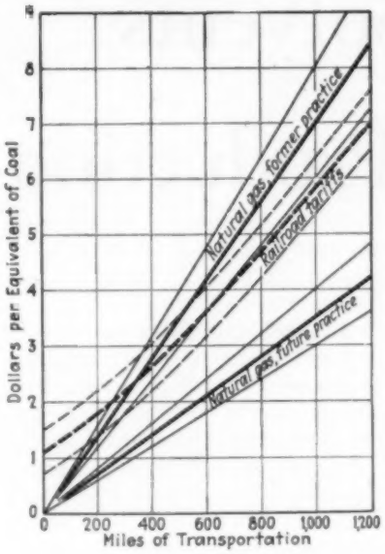
LOW-TEMPERATURE carbonization of coal was afforded both support and an oratorical obituary at the conference sessions. About a dozen papers were presented bearing on specific systems of low-temperature coking or on the broad principles applicable to these processes. All but two of these related essentially to European practice. They afford for the American chemical engineer material that is consequently largely of academic interest. It seemed the almost universal opinion that however successful in Europe, these processes could not find early application in the United States because of the widely different economic relationship. It is clearly recognized that anyone who is undertaking to make an American development of low-temperature coal processing should secure and critically analyze all of these contributions, particularly those of outstanding merit presented by Dr. R. V. Wheeler and his associates.

Frankly presented as an obituary oration, the paper by R. P. Soule, of Tri-Continental Corp., presented his views on "lessons from low-temperature carbonization." Dr. Soule analyzed the three major attempts at low-temperature coking made on a commercial scale in the United States, both from a technologic and an economic point of view. His conclusion was that either from the standpoint of the byproduct manufacture, as a starting point in the making of boiler fuel, for complete gasification, or as a source of low-temperature tar and oil there appears no really strong case to be made for low-temperature products under existing American conditions. The speaker clearly left the impression, seemingly in convincing fashion with the majority of his audience, that there was no hope for this type of process even though one might resort to artificial respiration or forced feeding of this moribund, if not actually deceased, branch of the fuel industry.

IN sharp and outspoken contrast with these views, F. Puening, of the Koppers Construction Co., presented "a contribution to engineering in low-temperature carbonization." Three definite new proposals were offered. The first related to a new method of heating the low-temperature retorts which the author believes creates a uniformity in temperature within the retort which never before has been achieved. This system of heating depends on the recycling with partial make-up by new gas and frequent reversal of direction of the heating medium through an elaborate recuperator of novel design.

The second proposal provides for coking of the crushed coal in very thin layers, usually 4 in. or less, in a device of which the walls of the coal chamber would be movable. By this scheme it is anticipated that very great carbonizing capacity per unit heating surface would be obtained. Furthermore, it would not be required that the coal be blended in order to have a shrinking or non-expanding mixture. Removal of the coke formed, even in these thin layers, would be certain and easy, because of the movable walls; this despite the desirability of using strongly tamped coal charges. Based on this system, Mr. Puening estimated the processing of 16 lb. of coal per square foot of heating surface per hour, an amount at least six times as great as now handled in the modern silica-refractory coke oven.

The third proposal of this author was a regenerative




**Relative Costs of Coal and Natural Gas Transportation in the United States**

Heavy lines show average; light lines, the fluctuation

coking system in which fine coal would be heated by mixing it with hot steel or refractory balls and subsequently separating the fine semi-coke from the balls. This system of carbonization is proposed for producing semi-coke to be used in boiler firing or other fine-fuel fired furnaces.

Mr. Puening estimated costs and profits of operation of his proposed system of carbonizing at low temperature on the assumption of 100 per cent capacity load factor under local circumstances to make both coal and semi-coke worth $3.50 per ton. His estimate of byproducts calls for motor fuel, solvent naphtha, and topped tar. In the course of the discussion he estimated that if local conditions afforded coal at $1.80 per ton, and corresponding prices for coke and byproducts, the profits to the investor would be 23 per cent per annum. It was stated that plans for the new system on a commercial scale had been drawn, but that the erection of a plant had not been undertaken.

GASIFICATION of coal other than by low-temperature processes received attention from the standpoint of coke ovens, vertical retorts, water-gas machines, and producers. Much of the discussion relating to coke ovens bore on European practice. Dr. Wheeler presented, among his other papers, one on the fundamental behavior of coal constituents affecting coke formation, concluding that the function of fusain in coal is to provide during coking "nuclei for contraction" so that the shrinkage of coke during loss of volatile matter occurs more uniformly through the mass without the production of major cracks and complete fragmentation of the product. Progress in European engineering practice from the standpoint of the French and the German industry was presented by C. Berthelot and Kurt Baum, respectively.

Most directly applicable to American practice among the carbonization reports was the paper by Fieldner and Davis summarizing the five-year investigation in which the Bureau of Mines and the American Gas Association have been working jointly in an attempt to establish an accurate method of appraisal of the coke-making and gas-making properties of a coal through the use of a moderate-scale test. The results here summarized indicate clearly that substantially all of the characteristics of coke, gas, and byproducts are determinable in this procedure, even including that most difficult characteristic to forecast, the structure of the coke.

Speaking from three entirely different points of view, engineers of the Jones & Laughlin Steel Corp., DuPont Ammonia Corp., and Brassert Engineering Co. expressed full agreement with these federal investigators as to the practical significance of the 75-lb. retort tests. Apparently this procedure was accepted by these and others present as a reliable method for judging a new coal in advance of actual full-scale usage.

The manufacture of gas in both continuous vertical retorts, discussed by Barash and Tomlinson, and in intermittent vertical chambers, discussed by L. H. Sensicle, related primarily to British practice. Discussion by American engineers pointed out the close similarity of American advances, particularly the substantial advances in gas making when steaming of retorts is practiced.

Discussion of the use of byproducts from coking, either in ovens or retorts, was limited during the conference substantially to the slight attention given to ammonia. The extensive opportunity for agricultural development with ammonium sulphate was illustrated by Charles J. Brand, of the National Fertilizer Association, and Norman MacClintock, photo-geologist of the Koppers Research Corp.

Comparison of British and American practice was again brought out strikingly during the discussion of the paper by N. E. Rambush which described the new large-diameter high-capacity water-gas generators developed in Great Britain, primarily for such large chemical engineering plants as the atmospheric nitrogen plant at Billingham. These generators, of 15-ft. diameter and 10,000,000 cu.ft. daily blue-gas capacity, have included complete mechanization and numerous modifications that hitherto had apparently been limited to United States practice. The development of the British generators, however, has gone farther than in American practice, if judged from the standpoint of size and capacity of equipment. American engineers indicate, however, that there is no fundamental reason why such large generators cannot be built in the United States at any time the industrial demand warrants.

Other papers dealt with gas production by the Heller water-gas process using powdered fuel, the Winkler gas producer using fine coal, and the complete gasification practice of the Continent as described by Josef Gwosdz. Kemmer, discussing improvement in gas quality by a low-temperature cooling and by catalysis, argued vigorously for the making of gas for city supply completely freed from condensable and corrosive substances, including sulphur compounds, oxygen, and water vapor, and substantially complete removal of carbon monoxide from gas before distribution. The purification as proposed by this author would involve low-temperature procedures rather than gas washing. Removal of carbon monoxide would follow somewhat along the lines characteristic of American chemical engineering practice in the making of hydrogen from carbon monoxide and steam as a raw material for ammonia or methanol synthesis.

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CORRECTION—In a tabulation of state laws governing pollution of streams by industrial waste, appearing in the September issue of *Chem. & Met.*, indication should have been made that Pennsylvania, cooperated with industry in solving its problems, and that in North Carolina jurisdiction over pollution control is held by the Board of Health and the Department of Conservation, acting through the informal Stream Sanitation Committee.

# Recovery of Volatile Solvents For Resin Production

By C. R. MAHANEY

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AMONG the many applications of chemical engineering to industry, the recovery of volatile solvents is among the comparatively recent. This is due to several facts: *(a)* Up to several years ago, the industries using solvents were limited both in number and size. *(b)* Increasing cost of solvents and their increasing scarcity has forced industry to consider their recovery. *(c)* A new industry has arisen in which the methods of solvent recovery are applicable to the recovery of gasoline from natural gas. *(d)* Our contact with Europe during the War convinced American engineers that solvent recovery had passed the experimental stage and was both practicable and profitable.

Many factors which must be carefully studied enter into the problem. From an economic standpoint, the quantity and value of the available solvent must be considered. The temperature and pressure at which solvent is used, as well as the physical and chemical properties of the solvent, will also play an important part in its recovery. A careful survey of the location of the plant and its relation to economical water, steam, fuel and labor should be made. If a factory is situated in a densely populated district it may be imperative to recover or eliminate any objectionable fumes. The legal aspect of recovery must be investigated and an outlet for the recovered solvent provided.

After all of these features have been carefully investigated and studied there are perhaps six methods of solvent recovery from which to choose.

### Six Methods of Recovery

*Condensation With Cooling Water*—Solvent in vapor form may be condensed by the removal of heat at the condensation temperature in two ways: direct and indirect cooling. Direct cooling consists of bringing the vapors directly in contact with the cooling medium. Indirect cooling introduces a dividing wall between vapor and cooling medium. This type is used when the solvents are water-soluble or when it is desired to keep insoluble solvents dry and out of contact with water. The difficulties with this method are: Moisture in air is condensed as well as solvent; high efficiency depends upon handling of very little air; best working condition with alcohol is 84 per cent solvent in air where there is danger of entering upper explosive limit through air leakage; and efficiency which may be as high as 70 per cent in winter may drop to 20 per cent in summer, due to rise in temperature of cooling water. However, the maintenance and operating cost of this system is very low.

*Compression and Cooling*—In general the compression system is used when the quantity of air is kept relatively low and the solvent recovered is not water-soluble. Solvent is removed from a closed or semi-closed system. It is not practicable in most cases to recirculate the denuded gas. Gas is drawn to a precooler, where it is cooled to within 10-20 deg. F. of the cooling-water temperature. The gas is then compressed to several atmospheres and condensed by passing through a water condenser. This method is costly both in installation and operation.

*Vacuum and Condensation*—This method usually is used for the recovery of alcohol from the dregs of extract manufacture or the removal of solvent from wood chips after rosin extraction. The apparatus is placed under vacuum, and the air, which is saturated with solvent vapor leaving the apparatus, is passed through a surface condenser.

*Adsorption*—Solvent-laden gases are drawn through coolers into adsorption towers. These towers may be filled with activated carbon, silica gel, ferric hydroxide gel or inert gas, depending on solvent to be recovered. After the adsorption medium has received its maximum charge the gas is diverted to another tower. Solvent is then recovered from the charged tower by steam distillation. If the recovered solvent is miscible in water, it will be necessary to remove water by distillation. If solvent is immiscible it may be separated by continuous decantation. This method is ideally suitable for recovering solvent mixed with large quantities of air. It is also possible to recover the last traces of solvent by this method, but it has a high installation cost and, with certain solvents, a high operating cost.

*Scrubbing*—This process is suitable for applications where solvent concentration in air is above 0.4 per cent. It consists of drawing solvent vapors through cooler (either direct or indirect, depending on solvent) to scrubber. Here the gas is scrubbed (countercurrent liquid principle) and the denuded air exhausted to atmosphere. The scrubbing medium containing the solvent is drawn to storage tanks. From here it is distilled and the solvent separated from the scrubbing medium. Water, cresylic acid, mineral oil, sulphuric acid and alcohol may be used as a scrubbing medium. The installation and operating cost of this system will depend on the solvent to be recovered and the scrubbing medium used.

*Chemical Treatment*—Chemical treatment consists of treating the solvent with some material which will enter into direct chemical union with it. The resulting product may or may not be valuable. In some cases the disposal of the resultant product (usually a solid) is almost as great a problem as the recovery of the solvent itself.

*Combination*—Any of the foregoing methods may be combined to effect the recovery of solvent mixture.

It is incorrect to say that one method of recovery is good and another bad. It is necessary to handle each individual problem on its own merits, basing the solution on experience gained from manufacture of solvent

recovery equipment, from inspection of working installations, and the proper application of principles of chemical engineering.

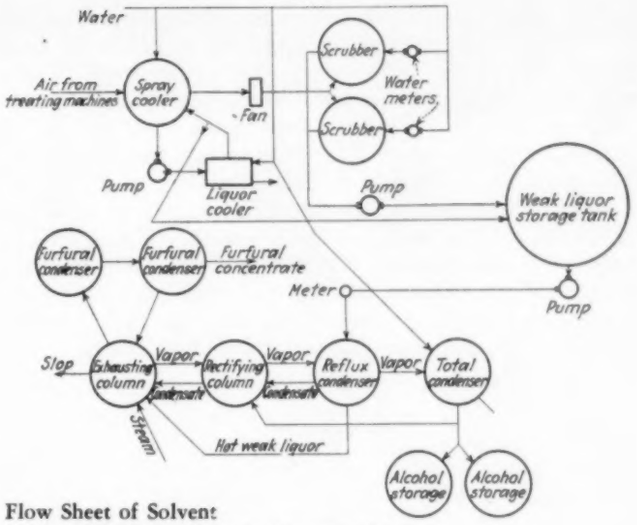
### Solvents in Plastic Manufacture

Large quantities of alcohol and other organic solvents are used in the manufacture of "Micarta," a laminated molded material made at the new Trafford Micarta works of the Westinghouse Electric & Manufacturing Co. In an endeavor to recover the alcohol and eliminate the fume nuisance, a thorough investigation of solvent recovery was made. A pilot plant was erected capable of handling 200 gal. of alcohol a day. This was applied to a duplicate of the treating machines on which the solvent was volatilized. Three methods of solvent recovery were tried (see cut below). These methods were condensation with indirect cooling water, adsorption with activated carbon, and water scrubbing. After two years' operation, during which detailed data were compiled, the water scrubbing method was selected as being best suited to the processes.

There were five main problems to be solved in adapting the water scrubbing method of solvent recovery to their processes. These were ventilation and safety; connecting several treating units to one recovery unit without loss of flexibility; cooling the air and solvent vapors; scrubbing and adsorbing solvent; and purifying solvent for re-use.

Since the main object is to manufacture Micarta, and any solvent recovered is a byproduct, the solvent recovery equipment must be adapted to fit the existing processes of Micarta manufacture. After measuring the maximum quantity of solvent vaporized per hour, a margin of safety of 50 per cent more air than required was chosen. The average concentration of alcohol in air leading from treating machines to solvent recovery equipment is 0.45 per cent; and the lower flammability limit, 3.85 per cent. This average is controlled by use of a vapor indicator. Care is taken to avoid dead spaces without circulation where fume concentration can build up. This is overcome by position of take-off pipes and baffles on treating machines.

Connecting several treating units to one recovery unit was solved by the use of sensitive furnace regulators. These regulators are electrically operated and control butterfly valves in the pipes connecting the treating machines to the main air duct. By maintaining a constant suction in the draw-off pipe of each treating machine these regulators hold the air flow steady regardless of small speed variations in the main exhausting fans and



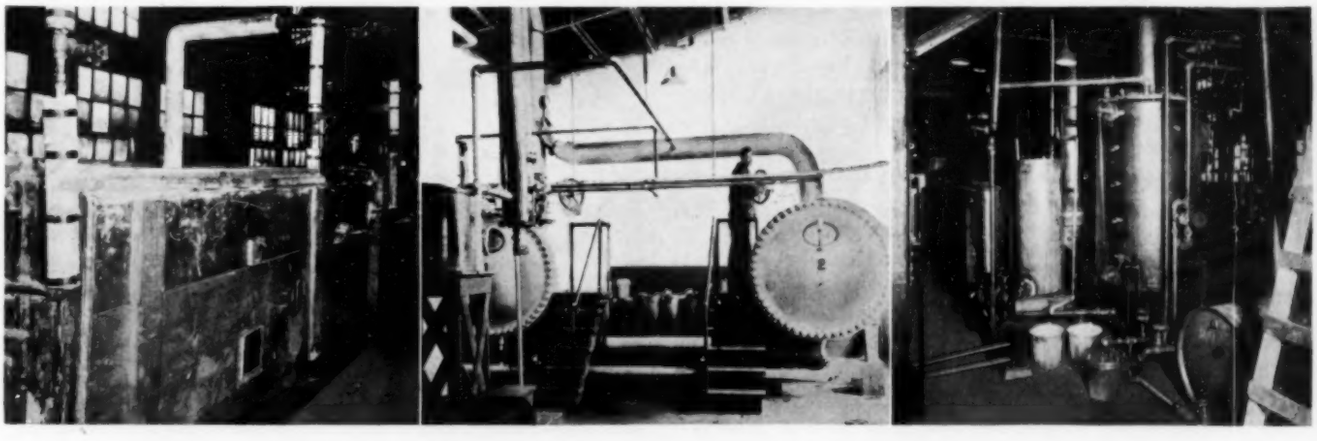

**Flow Sheet of Solvent Recovery System in Use in Micarta Plant**

changes on other machines. Fluctuations in suction are less than $\frac{1}{16}$ in. of water, which corresponds to a change in flow of less than 3 per cent. Hand valves are provided for shutting air off completely.

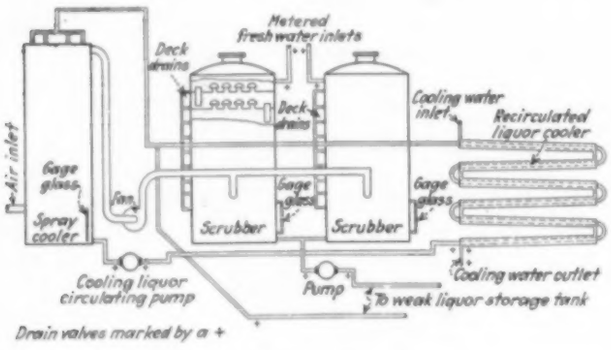
Cooling the solvent vapor which is mixed with large quantities of air is complicated by the presence of volatilized resin and fine solid particles which would quickly contaminate a surface-type cooler. This problem was solved by spraying recirculated cooling liquor through the air in a wooden hurdle tower. The recirculating liquor is cooled in an S-type tube cooler. This liquor cleans the air while cooling it. At least one-third of the liquor must be removed and the volume made up with fresh water every eight hours or it will become too viscous to spray properly. Material washed out by recirculated liquor is chiefly high-boiling solvents with some liquid and solid resin. Cleaning the air before it reaches the fans eliminates the necessity of frequent cleaning of the fans.

Countercurrent contact between the air and absorbing water is a most important feature. This positive contact is secured by the use of bubble caps. The chief advantages of the bubble cap tower over the packed tower are its small size and more efficient absorption. The disadvantages are higher pressure required to force air through it and higher initial cost. The bubble cap tower was selected for this installation to cut losses from incomplete absorption and to reduce distillation cost.

**Trial Methods of Solvent Recovery: Right, Condensation Method; Center, Adsorption With Activated Carbon; Left, Water Scrubbing**



The weak liquor obtained by absorbing alcohol vapor in water has an average composition of 2.75 per cent alcohol and 97 per cent water. The remaining 0.25 per cent is high-boiling liquid and entrained resin. A continuous still is by far the most economical means of concentrating the alcohol and removing the impurities. The two-column copper still used here is very close to the equipment used in the standard practice of distilling industrial alcohol from a molasses mash. The main difference is that the fusel-oil separator has been modified to act as a separator for the high boilers. This separator continuously removes from the still all impurities that are of a higher boiling point than alcohol and




**Cooling and Scrubbing System**

distill with steam below 100 deg. C. Impurities not distilled with steam all go to the sewer with water.

The blowers, of the Sirocco type, are two in number, one being a spare, each driven by a 50-hp. motor. These blowers are capable of giving a pressure of 30 in. of water at full air rating. A pressure of about 18 in. is required to force the air through the scrubbers at full load.

### Details of Alcohol Recovery

The details by which alcohol solvent is recovered may be followed by referring to the accompanying flow sheets.

*Air Collection Piping*—One main air pipe carries air from all the treating machines to the recovery system. Each treating machine is connected to the main air pipe by a smaller pipe in which is located a hand valve for shutting off the suction when the machine is shut down and an electrically operated butterfly valve to control the suction when the machine is running. These regulating valves have been adjusted to allow 50 per cent more air to pass than is required to keep the concentration of solvent vapor below the lower explosive limit when the maximum evaporation of solvent is taking place. It is important to keep the concentration of solvent vapor below the lower explosive limit because otherwise a fire in one machine would be carried to all the others. The average concentration of alcohol vapor in the air going to the solvent recovery system is about one-half of one per cent by volume.

*Cooling System*—The air from the treating machines goes first to a spray cooler, where it is cooled by coming in contact with cool recirculated liquors. This liquor is in turn cooled in a tube type cooler before it is returned to the top of the spray cooler. The spray cooler is packed with wooden slates to increase the contact surface between air and water. Besides being cooled, the air is washed clean of gummy material which would tend to clog the blowers.

From the spray cooler the air goes to the blowers. The air has been under a slight suction up to this point and is under a slight pressure the rest of the way.

*Scrubbers and Storage*—Next, the air goes to the scrubbers. There are two scrubbers in parallel supplied with city water through separate meters. Each scrubber has nine decks with 114 bubble caps on each deck. The bubble caps force the air to bubble through the water on each deck so that the air must be washed nine times with water to get through the scrubbers. The washing is countercurrent, so that the air containing most alcohol vapor comes in contact with water containing most alcohol and the air with least alcohol vapor comes in contact with fresh water entering the top of the scrubber. The tops of the scrubbers are open so that they discharge to the atmosphere.

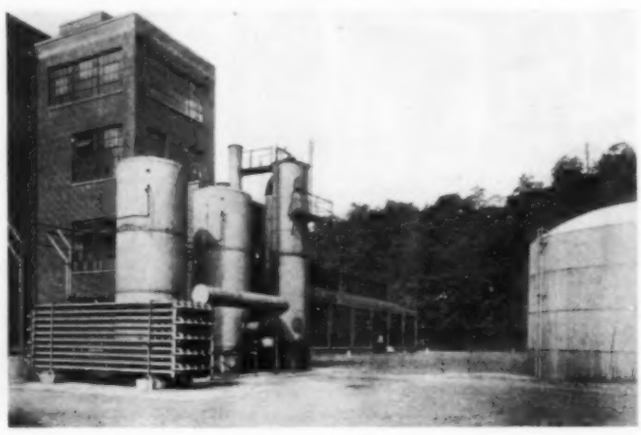
From the bottom of the scrubbers the weak liquor (97 to 98 per cent water, 2 to 3 per cent alcohol) is pumped to a 150,000-gal. storage tank. This tank is provided to permit running the still part time at full speed instead of full time at varying speeds. It also makes possible a shutdown of the still for repairs.

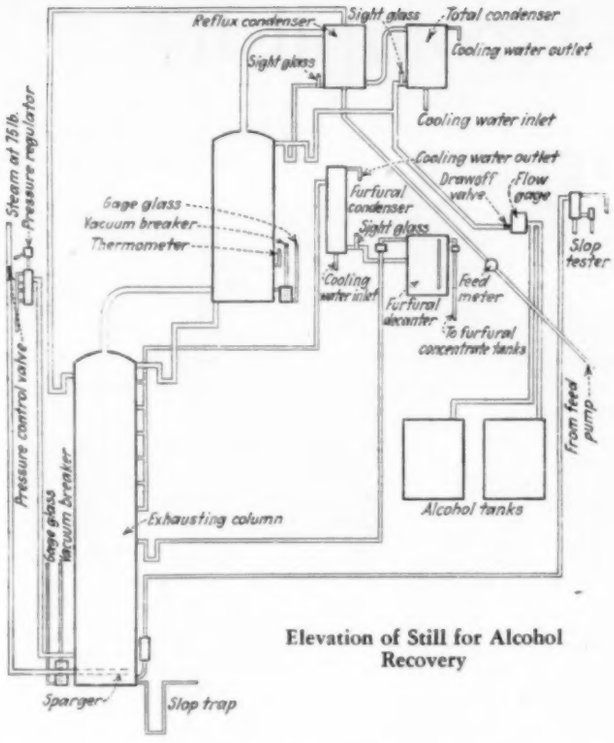
*Still*—This consists of an exhausting column for vaporizing the alcohol in the weak liquor; a rectifying column for separating the alcohol vapor from the steam in the mixture which it receives from the exhausting column; and equipment consisting of a condenser and decanter for separating high boiling impurities.

The weak liquor is pumped through the reflux condenser (where it serves as a cooling medium and is heated) to the top of the exhausting column. The exhausting column has sixteen decks fitted with bubble caps and overflow pipes very much like the decks in the scrubbers. Steam is blown into the bottom through a sparger (perforated pipe). As the steam comes into countercurrent contact with the weak liquor it vaporizes the alcohol and a small part of the steam is condensed. A mixture of about 25 per cent alcohol vapor and 75 per cent steam goes from the top of the exhausting column to the bottom of the rectifying column. The rectifying column has twenty decks of bubble caps. The steam-alcohol mixture bubbles through liquid of increasing alcohol content as it goes up through the column and at each bubbling part of the steam it is condensed and part of the liquid alcohol is vaporized (because it boils at a lower temperature than the steam condenses).

At the top of the rectifying column the alcohol vapor-steam mixture contains only about 5 per cent steam. As the mixture goes through the reflux condenser, part of it is condensed to supply reflux. By reflux is meant the liquid (with alcohol content decreasing as it goes

**View of Scrubbers, Coolers, and Storage Tank**






**Elevation of Still for Alcohol Recovery**

down the column) that comes in contact with the ascending alcohol vapor-steam mixture. Not all the alcohol vapor-steam mixture is condensed in the reflux condenser. Part of it goes to the total condenser, where it is condensed and cooled. Just enough of this condensate is drawn off as final product to maintain a constant quantity of alcohol in the rectifying column. The rest goes to the rectifying column as reflux. A thermometer near the bottom of the rectifying column shows the boiling point of the alcohol-water mixture on that deck, which in turn is a measure of the total alcohol in the column. By watching the thermometer the operator is able to so regulate the draw-off of alcohol that the same quantity of alcohol remains in the column at all times. The still is so regulated that alcohol is recovered with the same denaturants as were in it originally. All of it is re-used in the processes of Micarta manufacture.

There are certain impurities in the weak liquor that are higher boiling than alcohol but distill with steam at a temperature lower than the boiling point of water. These impurities (mostly furfural, phenol and cresol) build up on certain decks in the exhausting column. To keep them from building up to a concentration sufficiently high to allow them to distill with the alcohol, vapor from above one of these decks is conducted to the furfural condenser. The condensed liquid runs to the furfural decanter, where it separates into two layers. The lighter liquid is mostly alcohol and water and is returned to the exhausting column. The heavy layer, consisting of furfural, phenol, cresol and a little water, is run into receiving tanks to be later refined.

Corrosion of the equipment has not been a serious factor, although each installation will present an individual corrosion problem. The average water consumption is roughly 100 gal. per gallon of alcohol recovered. The average steam is 60 lb. per gallon of alcohol. The temperature of cooling water varies from 42 deg. F. in winter to 75 deg. F. in summer. The over-all alcohol recovery efficiency varies in winter months from 85 to 95 per cent and in summer months from 70 to 85 per cent.

# Making Good Glass From Blast Furnace Slag

By C. A. BASORE

*Professor of Chemical Engineering*
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LITTLE WORK, apparently, has been done on the conversion of blast-furnace slag into glass. The literature shows certain not very promising results attained, mostly with slags of other than blast-furnace origin. However, analysis of blast-furnace slag shows it to contain lime and silica, both of which are essential in making glass. The slag also contains alumina which, according to the literature, is beneficial in glass. These facts therefore suggested that a study* be made to determine a method of utilizing slag in the manufacture of glass, without preliminary treatment and without the removal of any of its original constituents.

A method has been worked out in both small- and large-scale laboratory apparatus, yielding a transparent, light-green or almost colorless glass of excellent properties, in many respects superior to ordinary soda-lime glass. It appears to be suitable for bottles and jars, corrosion-resistant kettle linings, structural and decorative purposes, and for X-ray bulbs, goggles and the like.

Preliminary consideration of the problem of converting slag quantitatively into glass showed that account would have to be taken of the sulphur and iron present as impurities and that the proportions of silica and CaO would have to be altered considerably by the addition of sand. Fortunately it was discovered that glass sand was not needed and that ordinarily pure building sand would serve except where demand for a whiter glass would make the use of glass sand advisable.

The mix that has been used contains 7 parts of granulated slag, 8 parts of sand, 1.76 parts of soda ash to reduce the fusion temperature and improve the working properties of the glass, and five parts of hydrated sodium sulphate per 40 parts of the mix, added to reduce the formation of scum. Removal of sulphur and oxidation of the iron to the less objectionable ferric condition are accomplished by the addition of about 1 per cent of arsenic trioxide which, with the sulphur, forms the volatile arsenic trisulphide or pentasulphide. The melting and reaction require 100 to 180 minutes at 2,500 to 2,600 deg. F., after which annealing of the formed product is carried out at a maximum temperature of 1,200 deg., the glass being allowed to cool slowly in the furnace.

Conservation of much heat is possible when, instead of using granulated slag, slag direct from the blast furnace is poured on top of the other materials contained in a fireclay crucible. Both methods have given satisfactory results. In view of the low cost of such glass and the high tensile strength, comparatively low coefficient of expansion, good thermal endurance, and high resistance to corrosion by hot 2N sodium hydroxide, boiling HCl and boiling water, the glass would seem to be of considerable interest as a profitable method of slag utilization.

*Results of this investigation are fully set forth in a pamphlet by the author (Bulletin 3), issued by the Engineering Experiment Station, Alabama Polytechnic Institute, under the title, "A Transparent Aluminum Glass From Blast Furnace Slag."

# Reversed Currents Accomplish Two-Stage Spray Drying

By PAUL D. V. MANNING
*Pacific Coast Editor, Chem. & Met.*

SPRAY DRYING as a unit operation has been rather neglected by chemical engineers until recent years. This has been due in part to prejudice against this type of process, caused by large size and cost of plant required for small production, cost of operation, difficulties of atomizing the feed and, finally, the state of the patent art.

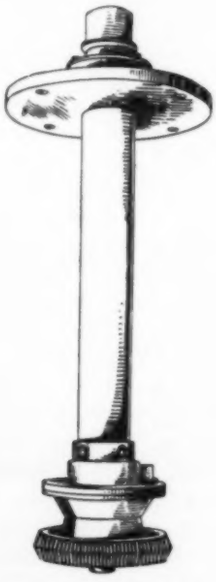
Recognizing that if such disadvantages could be overcome, spray drying would become one of the most useful operation tools of the chemical engineer, David D. Peebles, of Eureka, Calif., began experimental work, a number of years ago, on an entirely new type of spray dryer. The apparatus has recently been perfected, suitable patent protection obtained, and a number of installations are now in operation. The system developed is entirely new and appears to open up great possibilities in the use of spray drying as a unit operation.

Spray drying is advantageous because it combines in one operation three unit operation steps: namely, concentration, drying, and grinding. To be satisfactory, it must dry without injuring the product and produce a uniform and controllable particle size. It must require a minimum of labor, be easily operated, be compact and economical of both space and power.

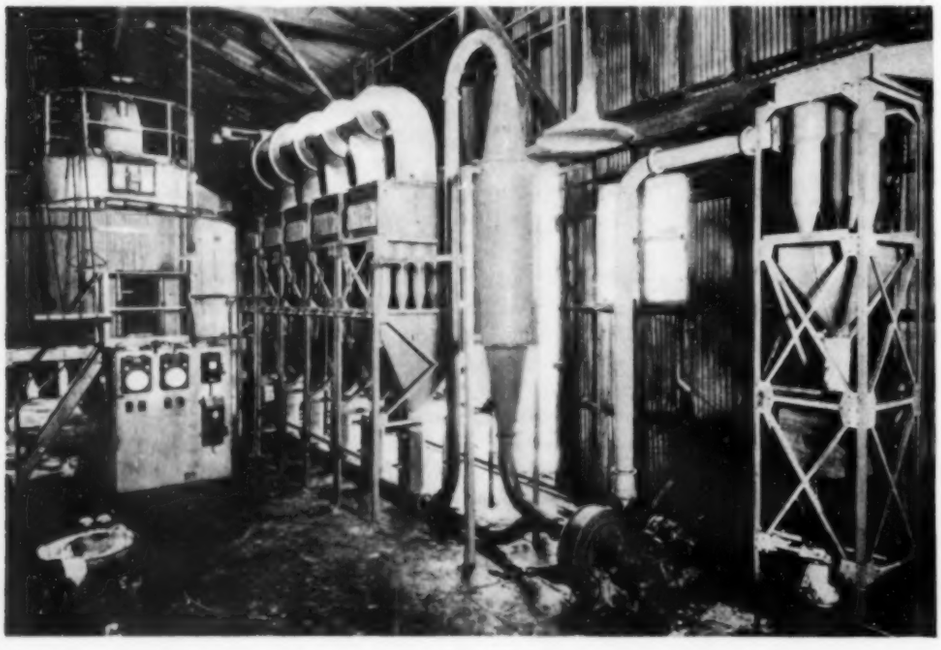
The Peebles spray desiccator as usually built at present consists of a desiccator chamber from 8 to 12 ft. in diameter and about 8 to 10 ft. high. The bottom is slightly conical upward and the top is flat or conical upward until it reaches a jacketed, inverted truncated cone which extends down into the desiccator, surrounding a center tube 12 in. in diameter through which the shaft of the atomizer passes. Between the lower end of this tube and the cone there is an annular space about 8 in. in width in which are radial vanes or louvres, tilted at an angle of about 45 deg. to impart a swirl to the hot gas as it passes into the chamber through the annular space. Hot gas is admitted to the space between the tube and the cone from supply pipes at the top. The space serves as a plenum or buffer between the hot gas supply and the chamber.

Around the cones there is an outer jacket supplied with cold air which passes into the dryer at the lower edge of the cone through an annular orifice about $\frac{1}{4}$ in. wide. This cold air prevents the formation of eddy currents due to the high velocity of the hot gas as it leaves the vanes. It also cools that part of the cone inside the desiccator so that dried or partially dried particles of powder cannot stick and burn.

As already noted, the atomizer shaft housing, carrying the shaft assembly, extends down into the desiccator through the 12-in. central tube. The atomizing runner is about 6 to 8 in. in diameter and about 1 to $1\frac{1}{2}$ in. high. The plane of its upper surface is placed about 4 in. below the plane surface of the lower edge of the vanes. A small quantity of cold air is passed between the atomizer shaft housing and the tube during operation of the desiccator. This keeps the shaft assembly and the runner cool, furnishes air to assist in atomizing, and obviates any tendency for partially dried material to whip back into



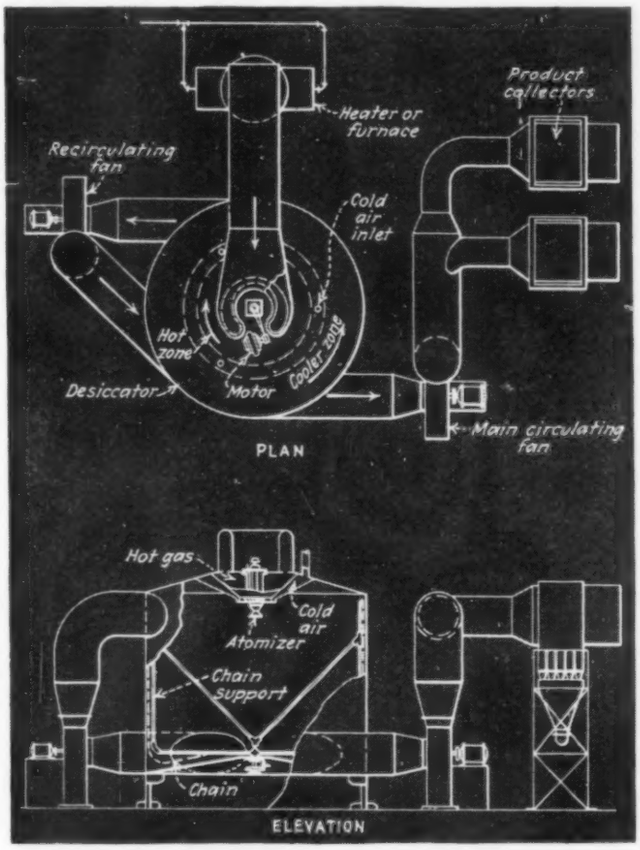
Above: Centrifugal Atomizer Assembly; Drive Pulley at Top, Slotted Spray Runner at Bottom



Left: Peebles Spray Desiccator With Multiclone Collection Unit Used to Produce Dry Powder From Molasses Slop, a Difficult Problem, on Account of the Hygroscopic Character of the Material

the atomizer runner, vanes, or into the stream of atomized particles coming from the runner. It also assists materially in the distribution of the atomized particles into the drying gases. The space through which this cold air passes is also utilized for feed pipes.

Atomizing is accomplished by centrifugal force. The liquid feeds into the inside of an inverted hollow cone




**Plan and Elevation of a Peebles Spray Desiccating Unit**

which surrounds the lower end of the shaft. It distributes from this into the inner saucer of the runner. This inner saucer has milled slots through which the liquid is distributed in a number of streams to the outer milled slots of the runner, and this beating action, coupled with the effect of the centrifugal force in breaking up the film, is responsible for the atomizing. The action is assisted by the flow of air, as previously noted. The runner acts to some extent as the rotor in a fan, and as the material is atomized it is mixed with drying air, this distribution being partly responsible for the success of the operation.

Ball bearings, which take both the radial and thrust load, carry the atomizer shaft. They are mounted on rubber to cushion any vibration due to critical speeds and unbalancing of the runner by liquid feed. They are lubricated by a simple system requiring only a little attention, not oftener than once in from 24 to 48 hours. Long and satisfactory bearing life is attained.

A 3,600-r.p.m., 10-hp. horizontal-shaft motor drives the atomizer shaft through a quarter-turn Rhoads "Speedelite" belt made of specially processed cotton. Proper tension and contact are assured by a ball-bearing idler controlled by a weighted arm. This is the same type of drive that has been successfully used for a number of years on the Sharples Super Centrifuge. The belt does not slip at all, is perfectly silent, and will transmit considerably more than the rated power of the motor. It has a life of from 200 to 500 hours of continuous operation and a cost of about $2.50 per belt.

When a steam turbine is used instead of an electric motor it is possible to vary the atomizer speed without changing pulleys or using a variable-speed motor. Speeds of operation generally range from 6,000 to 13,000 r.p.m.

A short, vertical shaft through the bottom of the desiccator chamber supports a light crossbar carrying at its ends vertical arms to which a light chain is fastened. This mechanism revolves at about 30 to 60 r.p.m. and the chain removes any particles which might tend to adhere to the walls or floor, forcing the particles into the exit air stream. This apparatus is driven by means of a small "sail" on the lower part of each arm or by a small motor.

There are two tangential air outlets, located at opposite points on the side walls of the chamber at the bottom. Gas entering one of these outlets is drawn through a fan and discharged tangentially into the upper part of the desiccator chamber in a direction *opposite* to the rotation of the hot gas entering from the inlet vanes. This recirculation causes an outer, colder vortex zone to revolve around the inner hot zone. Together with proper atomizing and elimination of eddy currents, this feature is responsible for the success of the Peebles system. The quantity of gas recirculated varies from 20 to 100 per cent of the weight of heating gases put into the system.

The second outlet leads to the powder-collecting system, preferably through the main fan, which in turn connects with the filters, Multiclones or other collectors.

### Hot Gas Supply

Heat for drying may be produced in several different ways, depending on local conditions and on the nature of the material being dried. In cases where the material is deleteriously affected by gaseous products of combustion, it is necessary to use a heat exchanger. A special type of countercurrent heat exchanger, which is simple, low in cost and high in efficiency, has been developed for the Peebles system. This exchanger consists of sections or passes, each made up of a number of tubes, usually 4 in. in diameter and about 4 to 5 ft. long. Drying air passes over the tubes, and counter to the flow of hot gases. In a four-pass heater, for example, gases from the furnace pass through the tubes of the first section, then through the tubes of the second section, then through an induced draft fan, and then through the tubes of the third and fourth passes.

Gas leaving the last pass is divided, part going out the stack, while the remainder goes to a mixing chamber at the rear of the furnace combustion chamber, where it is mixed with the high-temperature gases from the fire and recirculated through the heating system. In order to keep the heat transfer coefficient high, it is necessary to cut down the film effect as much as possible, and this is done by using a large volume of gas. This also permits the use of lower temperatures on the flue gas side, thus increasing the life of the apparatus. These reasons, plus economy, explain the use of partial recirculation.

Where the material being desiccated is not injured by the products of combustion, waste stack gases may be used directly, or a small oil or natural-gas furnace is provided for heating the drying air without the use of the heat exchanger. Both oil and gas are being used in this manner with entire satisfaction.

In operation, the double drying zone maintained by the hot inner zone and cooler outer zone provides for

drying without injury to the product and yet permits the use of a very high temperature inlet gas. This, in turn, means a very high desiccating capacity per unit of volume. The feed is atomized so thoroughly and so uniformly, and mixed so well with the drying gas, that an enormous surface is presented for evaporation. During this infinitesimal period of time when the particles are in the high-temperature inner zone, the heat conductivity of the material is high, for it is in the liquid state; and although the hot inlet gas is carried at a very high temperature, the liquid particle is kept cool by evaporation.

Although it is customarily stated that organic products are easily injured by heat, this is only a partial statement of fact. Organic materials such as milk and tan liquor are very easily injured by heat if uneven evaporation is allowed to take place and if the heat is applied for an appreciable time. Time of contact, as well as degree of heat, is therefore a factor, and in the Peebles system it is made the controlling factor.

### High Velocity in Hot Zone

Atomized material leaves the runner and flashes through the inner high-temperature zone, where most of its water is removed. As the material becomes a solid, with a relatively low heat conductivity, it passes into the outer low-temperature zone, where drying is carried to conclusion at a temperature low enough to avoid injury to the product. Powder cannot reenter the inner zone because of the centrifugal force exerted by the rotation of the outer zone. Thus drying is definitely accomplished in two stages: in the inner zone, where the temperature is high and the time of contact exceedingly short, and in the outer zone where the time is much longer but the temperature much lower. The temperature to be used in the second zone depends on the residual moisture desired in the product and the point of injury to the product by short-time contact with heat.

Once the material is dried it is not allowed to remain in the chamber, for lengthy contact even with low temperature is injurious to many organic products such as milk. The dry powder is swept out by the air stream and passes to suitable dust collectors. For example, in the daily operation of a Modesto (Calif.) plant producing 1,000 to 1,200 lb. of dry skim milk per hour, there is less than 20 lb. of product in the desiccating chamber at any time, as a result of the fact that the chamber walls are kept almost entirely clean.

During the infinitesimal period of time when a particle of material is in the hot inner zone, it is protected from oxidation by a film of evolving water vapor which surrounds it. Thus it has been found possible to dry substances which are easily decomposed by low heat and oxidation, practically without decomposition.

Since the gases for the second zone are supplied by those from the hot zone and are first cooled by evaporation of atomized liquid, temperature of the inlet gases and quantity of liquid fed to the atomizer control the whole operation. In the last analysis, therefore, the quantity of heat supplied and the capacity of the atomizer become the controlling factors. The size of the desiccator, within limits, has little to do with the drying. The chamber is made only large enough to provide for thorough mixing of atomized particles with drying gas, but not so small as to increase power consumption.

Control of size, shape and uniformity of product is attained by proper atomizer design and speed, as well as by selection of the proper temperature for the hot zone. Many factors must be considered. The atomizer must continuously atomize with a uniform fineness. This is an absolute essential. Particle size of the product depends also on concentration of solids in the feed, size of the atomized particle, heat conductivity of the liquid feed, and temperature gradient of the inner zone. Atomized particle size depends on whether the material is a true solution, a colloid or a slurry, as well as on the surface tension of the feed and on the design, size and speed of the atomizing runner.

As these various factors are all determined by the design, or in the case of flow and temperatures, controlled by automatic instruments, operation requires only the part-time attention of one man, who is thus able to produce a high output per man-hour. To bear out this fact, as well as the other advantages of the process, the operating data of several typical installations are of interest. In a certain plant making dry skim-milk powder the desiccating chamber is 12 ft. in diameter and 10 ft. high. Skim milk concentrated to 33 per cent solids is fed to the atomizer. The inlet hot air is heated by a heat exchanger and enters the drying chamber at 800 deg. F. Dry powdered milk is produced at the rate of 800 lb. per hour at a cost for fuel, labor and power of $0.004 per pound of product. The product meets all specifications for dry skim-milk powder and cannot be told from unprocessed skim milk when it is remade to skim milk.

A second California plant now in operation, using a chamber of the same size, with an inlet air temperature of 500 to 600 deg., produces 1,000 to 1,200 lb. of dry skim-milk powder per hour with feed of about 40 per cent solids.

Working on kraft-pulp black-liquor concentrate with a chamber 8x8 ft. and a feed of 65 per cent solids, dry powdered "black liquor" was produced at the rate of 3,500 to 4,000 lb. per hour. There was no cracking or decomposition of the organic materials. The inlet gas temperature was varied from 700 to 1,100 deg. F., the gases being taken from the stack and one of the passes of a waste heat boiler. In this installation a steam jet atomizer was used instead of the centrifugal atomizer, because it was necessary to keep the feed hot.

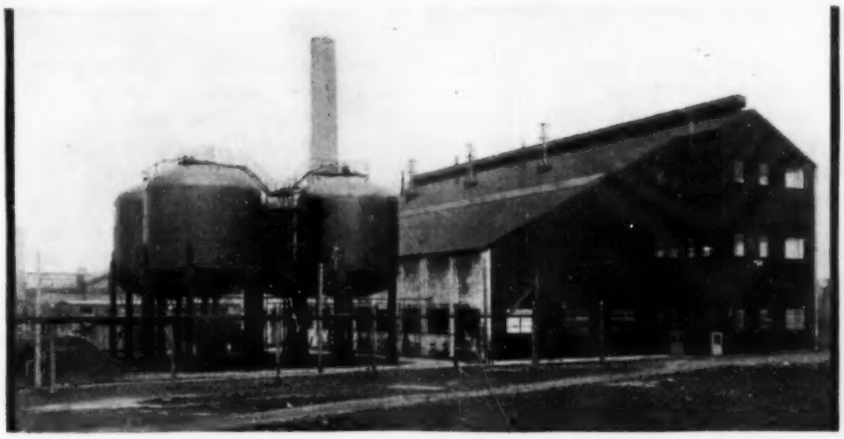
### Heat Losses Low

When direct use of gaseous products of combustion is possible, the only heat loss in a Peebles desiccator consists in radiation and the small quantity of heat left in the low-temperature exit gases. When indirect heating of drying gas is used, stack losses are minimized by use of a partial recirculation of the flue gas. Where waste stack gases are available, operating costs are even lower.

On account of the small size of the apparatus and its high producing capacity, the plant can be constructed of alloy metals without very great cost. Plant space occupied is small, a unit for 1,000 lb. per hour occupying a total floor space of 15x20 to 25 ft. (depending on the source of heat), and requiring about 15 ft. headroom. This is exclusive of the collecting system.

Due to its high temperature gradient, the system requires a relatively small weight of drying gases. This means that the volume of the exit gases is low, thereby simplifying the collection of the finished product. For the same reason power consumption is low and the heating problem is simplified.

For the opportunity to prepare this article, *Chem. & Met.* expresses appreciation to Mr. Peebles, to the Western Condensing Co., of San Francisco, and to the Western Precipitation Co., of Los Angeles, manufacturers of the Peebles dryer.



*Platinum Contact Sulphuric Acid Plant of Canadian Industries, Ltd., Copper Cliff, Ont.*

## *Which Sulphuric Acid Catalyst—*

# Platinum or Vanadium?

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***On several occasions in the past, Chem. & Met. has published material supporting the claims of the vanadium catalysts for sulphuric acid. We are now fortunate in being able to show the other side of the picture, as presented in a paper given by Dr. Thompson at the current meeting of the American Institute of Chemical Engineers. For discussion of this paper, the reader may refer to the Institute report on page 694 — Editor.***

SULPHURIC ACID, notwithstanding the technical assaults that have been made on it in recent years in an attempt to replace it in many chemical processes, still retains its position as the so-called barometer of the chemical industries. The quantity of sulphuric acid produced in recent years has exceeded that of any other chemical, as has the value. However, the sulphuric acid industry is on a highly competitive basis and profits have not been great. Consequently, manufacturers have been interested in any improvement in process that promises a reduction in costs.

While improvements have been made in the chamber process, it is in the contact process that the most striking developments have taken place in recent years, both in design and engineering as well as in the catalysts used.

Since 1901, when Dr. Knietsch delivered his famous lecture before the German Chemical Society on the contact sulphuric acid process as developed in the laboratories and plants of the Badische Co., platinum has been the classic example of an effective contact agent or catalyst. Due mainly to three considerations, much experimental work has been carried out in an effort to discover suitable catalysts whose activity would approach that of platinum and which would cost less to prepare and be unaffected by poisons in the gas undergoing treatment. These considerations have been: (1) the relatively high cost of platinum (particularly during the War period and up to nearly two years ago) coupled with the schemes of catalyst preparation formerly in use, which called for a much larger quantity of platinum than is now required to effect equivalent conversion; (2) the fact that platinum was "poisoned" by the presence of arsenic in the gases; and (3) the patent status, which restricted the situation with respect to the use of platinum catalysts.

With the possible exception of the ferric oxide catalyst used in the first stage of the Mannheim process, none of the catalysts resulting from this work was commercially important until the appearance of the vanadium pentoxide mass first successfully introduced by the Monsanto Chemical Works, of St. Louis, Mo., a little over five years ago. Shortly after, the Selden Co., of Pittsburgh, Pa., put its mass on the market. Both of these contact masses were developed by Dr. Alphonse O. Jaeger, a German chemist formerly in the employ of the Badische Co. More recently the Calco Chemical Co., of Bound Brook, N. J., has introduced a vanadium pentoxide mass.

The original announcement concerning the commercial availability of the vanadium catalyst was made at a singularly auspicious time. If we disregard the unsettled conditions caused by the World War, the price of platinum was almost at its peak. At that time, also, the quantity of platinum in use per ton of acid produced was considerably greater than that now required, as a result of recent developments in the preparation of platinized catalysts. Furthermore, considerable publicity was given to the statement that vanadium contact masses were not affected by the presence of arsenic in the treated gases. Due to recent developments in platinized catalysts, design of plant, and uses for the acid produced, all of which will be discussed more fully later, this fact is not now so important as formerly.

Catalysts which are now in use for the manufacture

Condensed slightly from a paper presented under the title of "Platinum Versus Vanadium Pentoxide as Catalysts for Sulphuric Acid Manufacture," before the Atlantic City meeting of the American Institute of Chemical Engineers, Dec. 11, 1931.

of contact sulphuric acid and which are considered in this paper, are:

*Platinized Asbestos*—Asbestos has been used longer than any other substance as a carrier for platinum. Dr. Knietzch having used it in his work. At the present time a large proportion of the contact sulphuric acid made in this country uses this material as a catalyst.

*Platinized Magnesium Sulphate*—Magnesium sulphate has long been in satisfactory use as a carrier for platinum. This was originally developed as the Schroeder-Grillo mass. It is used extensively in this country.

*Platinized Silica Gel*—This mass has been developed by the Silica Gel Corp. The first commercial installation was made in May, 1926, in a Belgian plant. The successful results obtained with it there resulted in four other installations abroad. This material is in use also in seven units, totaling 175 tons of daily 100-per cent acid capacity, at the Davison Chemical Co.'s plant in Baltimore, Md. These plants are all successfully operating on gas derived from the burning of pyrites. Within the last year a new platinized silica gel mass has been developed which appears to give even better results than the masses of this type now in use. It is well known that silica gel has an enormously high surface area per unit of mass. The new mass is even superior to the old in this respect, having an apparent density of 0.5, as compared with 0.702. It is, therefore, an excellent catalyst carrier. A method has been developed for very effectively dispersing platinum on its surface. As in the case of the older mass, the new material is not adversely affected by the reaction gases, nor is it poisoned by arsenic. Furthermore, the new mass gives excellent results on gases of ordinary concentration as well as with $SO_2$ content as high as 10 per cent. With such gas, even at high flow rates, conversions have been around 97 per cent.

*Vanadium Catalysts*—As previously mentioned, the Monsanto Chemical Works, the Selden Co., and the Calco Chemical Co. have all developed vanadium catalysts which are in commercial use in the United States.

**Table I—Data and Preliminary Calculations on Contact Sulphuric Acid Catalysts**

(Life of all catalysts assumed ten years; see discussion below)

| | Platinized Magnesium Sulphate | Platinized Asbestos | Platinized Asbestos | Platinized Silica Gel | Vanadium Mass *A* | Vanadium Mass *B* | Vanadium Mass *C* |
|---|---|---|---|---|---|---|---|
| Type of mass | Granular | Fibrous | Fibrous | Granular | Granular | Formed | Formed |
| Source of gas | Brimstone | Pyrites | Brimstone | Pyrites | Brimstone | Brimstone | Brimstone |
| Composition of burner gas, per cent: $SO_2$ | 10 | 8.0 | 10 | 7 | 8 | 7 | 7 |
| Composition of burner gas, per cent: $O_2$ | 11 | 10.6 | 11 | 12 | 13 | 14 | 14 |
| Composition of burner gas, per cent: $N_2$ | 79 | 81.4 | 79 | 81 | 79 | 79 | 79 |
| Burner gas ($SO_2$ : $O_2$) ratio | 1 : 1.1 | 1 : 1.325 | 1 : 1.1 | 1 : 1.71 | 1 : 1.625 | 1 : 2 | 1 : 2 |
| Excess oxygen, per cent[1] | 120 | 165 | 120 | 243 | 225 | 300 | 300 |
| Catalyst used, lb.[2] | 166 | .... | ... | 194 | 191.5 | 200 | 200 |
| Catalyst density | 0.786 | .... | ... | 0.702 | 0.609 | 0.453 | 0.569 |
| Catalyst weight, lb. per cu.ft. | 49 | .... | ... | 43.8 | 38 | 28.3 | 35.5 |
| Catalyst volume, cu.ft.[2] | 3.39 | 4.04 | 3.23 | 4.43 | 5.04 | 7.06 | 5.63 |
| Platinum content, troy oz.[2] | 6 | 6.87 | 5.49 | 2.12 | .... | .... | .... |
| Platinum in catalyst, per cent | 0.248 | About 7-8 | About 7-8 | 0.075 | .... | .... | .... |
| Conversion, per cent | 95 | 95 | 95 | 95 | 96 | 95 | 95 |

[1]Per cent over theoretical.
[2]Volume or weight per daily ton of 100 per cent acid.

**Discussion of Table I**—This tabulation summarizes data and preliminary calculations on the several catalysts which are interpreted as follows:

*Composition of Gas*—The acid plants, whose operating results, and the calculations therefrom, are presented in the tables, are considered typical of the industry. It will be seen that all operate on a gas derived from the burning of brimstone, except the plant using platinized silica gel and one of those using platinized asbestos. Naturally, with the same sulphur dioxide content, a gas derived from the burning of pyrites will contain less oxygen than one obtained by burning brimstone.

It is to be noted that, based upon the same source of sulphur, gases containing higher concentrations of sulphur dioxide are used with the platinum catalysts than with the vanadium contact masses. This is no mere coincidence, as the following discussion shows. With any catalyst the law of mass action would indicate the desirability of an excess of oxygen rather than of sulphur dioxide in forcing the reaction to completion, since oxygen is by far the cheaper of the two reactants. However, since air, with its large nitrogen content, is the source of the oxygen used in roasting and burning operations, it is desirable that this excess of oxygen be small, in order to permit as high a concentration of sulphur dioxide as possible.

For satisfactory conversions, experience has shown that the vanadium masses require a very much higher ratio of oxygen to sulphur dioxide than platinized catalysts, thus placing in the case of the former a definite and rather low limit on the sulphur dioxide content of the gas that may be treated. As seen from the table, platinized magnesium sulphate and platinized asbestos both work quite satisfactorily with only 120 per cent excess oxygen, while 300 per cent excess oxygen is commonly used with the vanadium catalysts.

These facts, in the case of a new plant using a vanadium mass, mean the production of a more dilute burner gas than otherwise necessary, requiring larger blower and converter capacity than in the case of a comparable plant using the platinum contact mass, and consequently causing an advance in both construction and operating costs. In the case of substitution of vanadium for platinum in an existing plant treating a gas of high sulphur dioxide content, a reduction in the output and rated capacity results. Conversely, the substitution of platinum for vanadium permits the use of a gas of higher $SO_2$ concentration and, by making only very slight changes, if any, increases the capacity of the plant in the approximate ratio of the increase of gas concentration.

The specific reason for the unsatisfactory showing of the vanadium catalysts in handling a gas with a low oxygen-to-sulphur-dioxide ratio seems to be the fact that a large excess of oxygen in the gas being treated is necessary to prevent the reduction of an excessive quantity of the vanadium pentoxide to a lower oxide or oxides, the latter having much less catalytic power, or possibly none at all.

*Weight and Volume of Catalyst*—It appears that platinized magnesium sulphate requires the smallest weight, and likewise, with platinized asbestos, the smallest volume of catalyst per daily ton of 100 per cent acid. This means less converter space for the same acid production. This is partly, but not entirely, due to the greater sulphur dioxide concentration in the gas which the use of a platinized mass makes it possible to treat. The platinized silica gel at present in plant use is also superior in this respect to the vanadium catalysts.

*Platinum Content*—Platinized silica gel shows the smallest percentage of platinum and also the smallest quantity of the metal per daily ton of acid. These facts show the efficiency of the carrier and of the dispersion of the platinum thereon. From the standpoint of costs, the low platinum content is worth consideration, though not so important as formerly when the price of platinum was much higher than at present. Further, it must be remembered that 85 to 90 per cent of the platinum is recovered in the end anyway, still further reducing the costs directly chargeable to this element. As a result of this recovery, it can be seen that the only legitimate charges against the cost of the catalyst with respect to the platinum content are: the interest on the money invested in the metal, plus the value of the estimated metal loss.

*Conversions*—Conversions are all satisfactory and approximately equal. This is natural in view of the fact that in every case the gas loading or space velocity is so controlled as to give a certain predetermined conversion on gas of the composition treated. The figures given are about the minimum and are frequently higher. It is to be remembered, however, that the platinized catalysts are working with gases of higher sulphur dioxide concentration and with heavier gas loadings, as shown by Table II. Temperature—$SO_2$ conversion curves based on rigorously controlled laboratory experiments, under identical conditions, show that all platinized catalysts as now prepared are superior to the vanadium contact masses. At equal space velocities the temperature range over which high conversions are maintained is much broader with the platinized catalysts than with the vanadium masses. Further, platinized catalysts are capable of handling high overloads with far less reduction in conversion than the vanadium masses.

*Life of Catalysts*—In calculating the data on costs, the life of all the catalysts is taken as ten years. It is true that no vanadium or platinized silica gel contact masses have been in commercial use for so long a period, while many platinized asbestos and platinized magnesium sulphate masses have given this length of service and more. The first vanadium catalysts installed have been in use for about five years, as has an installation using platinized silica gel. Several instances where it has become necessary to replace the vanadium masses are known. However, with good plant design, including proper provision for cleaning the gas, and under satisfactory operating conditions, the life of these masses should be considerably longer than this period of five years.

In the case of platinum on asbestos and on magnesium sulphate, there have been many instances of masses whose life has exceeded ten years. The life of masses in the "B," or second, converter usually is over ten years. Naturally, they are subject to less severe operating conditions than those in the "A," or first, converter and frequently are longer lived than the latter, which nevertheless, when properly protected, have a life of at least ten years.

Certainly, with the present improvements in plant design and operating conditions, ten years is not an unreasonable life upon which to base calculations concerning the different catalysts. Actually it should be longer.

**Table II—Catalyst Duty in Contact Sulphuric Acid Plants**

| | Platinized Magnesium Sulphate | Platinized Asbestos | | Platinized Silica Gel | Vanadium Mass *A* | Vanadium Mass *B* | Vanadium Mass *C* |
|---|---|---|---|---|---|---|---|
| Source of gas | Brimstone | Pyrites | Brimstone | Pyrites | Brimstone | Brimstone | Brimstone |
| Space velocity[1] | 924 | 970 | 970 | 1,008 | 768 | 627 | 794 |
| Gas flow rate[2] | 0.315 | .... | .... | 0.384 | 0.337 | 0.369 | 0.372 |
| Conversion per lb. catalyst[3] | 3.93 | .... | .... | 3.37 | 3.41 | 3.26 | 3.26 |
| Conversion per lb. platinum[3] | 1,587 | 1,385 | 1,730 | 4,485 | ..... | ..... | ..... |
| Conversion per cu.ft. catalyst[4] (100 per cent conversion) | 8.44 | 7.082 | 8.86 | 6.14 | 5.39 | 4.02 | 5.09 |
| Conversion per cu.ft. catalyst[4] (at actual conversion) | 8.02 | 6.72 | 8.42 | 5.83 | 5.18 | 3.85 | 4.84 |

[1]Cubic feet of gas at N.T.P. per hour per cubic foot of catalyst.
[2]Cubic feet per minute per pound of catalyst.
[3]Pounds sulphur converted to $SO_3$ per 24-hour day.
[4]Pounds sulphur converted to $SO_3$ per hour.

**Discussion of Table II** — This table, which is a summary of calculations based on the plant data given in Table I, is of great importance in indicating the comparative technical value of the different catalysts. Other factors, which cannot be appraised in figures and yet enter into a determination of the efficiency of the catalyst, are considered on pages 708 and 709.

*Space Velocity*—It is remarkable that, notwithstanding the fact that the gases used with platinized catalysts (with the exception of the silica gel) have a higher sulphur dioxide content than in the case of those treated by the vanadium masses, the space velocity, or "gas loading," is also higher. The very satisfactory space velocity with platinized asbestos on a 10 per cent sulphur dioxide gas should also be noted. Based on the results given in the table, the average superiority of platinum over vanadium, ignoring the more concentrated gas handled by the former, amounts to about 33 per cent.

*Other Factors*—In cubic feet of gas per minute per pound of catalyst, platinized silica gel is superior to all the other contact masses. Vanadium catalysts show up much better here than in the other factors presented in the tables. However, it cannot be emphasized too strongly that comparisons involving the volume of catalyst rather than the weight are the important considerations in determining catalyst efficiency. Converters are designed essentially on the basis of volume of contact mass required and not on weight. Likewise, in measuring the performance of vanadium masses, and in their sale, the primary physical unit employed is one of volume rather than of weight.

In pounds of sulphur converted to sulphur trioxide per 24 hours per pound of catalyst, platinized magnesium sulphate shows up more favorably than any of the others, the other masses giving about the same figure. This relation is somewhat more important than the preceding one, but the same statements again apply.

Platinized silica gel gives by far the highest figure for pounds of sulphur converted to sulphur trioxide per 24 hours per pound of platinum. This probably is due to the very high effective surface presented by the platinum on the silica gel support. This figure was of considerable importance formerly when the price of platinum was much higher than at present and it is still of interest. The fact that most of the platinum in any contact mass is salvaged in the end should also be remembered.

In pounds of sulphur converted to sulphur trioxide per hour per cubic foot of catalyst at conversion actually achieved, platinized asbestos and magnesium sulphate are about on a par and decidedly superior to the other catalysts. Based on the results in the table, the average superiority of all platinum catalysts over the vanadium masses amounts to about 57 per cent. This factor and the space velocity discussed previously are of extreme technical importance in determining catalytic efficiency.

## Catalyst Comparison Tables

Three tables given as part of this paper summarize a study made of the technical and economic situation with respect to the several catalysts now in use. The vanadium contact masses in commercial use have been identified by letters: vanadium masses *A*, *B*, and *C*. The data on which these tables are all based were obtained in connection with actual plant operation and are believed to be representative of present-day plant practice. They give in a concise form fundamental data and the results of calculations as to service and costs of each catalyst. It must be borne in mind that plant design and control materially affect the result obtained. Under the circumstances existing in the sulphuric acid industry, this fact naturally favors the vanadium contact masses rather than the platinized catalysts, because plants using the former usually are of recent construction and represent the latest developments in technical achievement and plant design, whereas many of the plants employing platinum are old and use makeshift equipment.

It must be emphasized that the studies which these tables summarize are based on commercial practice; not on laboratory experiments. As a result, there are variations in the source and sulphur dioxide content of the gas treated by the various catalysts. The peculiarities of the individual catalysts are important factors in some cases in determining the permissible concentration of the sulphur dioxide in the gas entering the converters, as explained more fully in the discussion of Table I.

Table I gives comparative data regarding the different catalysts and also sums up the preliminary calculations. Table II summarizes the computations on the technical efficiency of the catalysts. Other factors more intangible and difficult of appraisal in cold figures than those presented in this table also enter into the determination of the proper catalyst and these are considered later. Table III summarizes the data on costs of the various catalysts. The life of all of them is taken as ten years, as is discussed in connection with Table I. In the case of the platinum catalysts, the value of the platinum content is computed at a metal price of $40 per troy ounce.

It becomes obvious from these tables and their accompanying discussion that the platinized contact masses are cheaper from every standpoint than the vanadium masses.

Since the War there have been decided reductions in the percentage and in the quantity of platinum in the contact masses per daily ton of acid. Evidence indicates that these decreases have been carried to an extreme and that from the standpoint of the acid producer, the opposite tendency is desirable and logical and very likely would result in an actual reduction in the cost of acid.

A study of the situation shows that certain technical advantages result from the use of an increased quantity of platinum. In this connection the decided technical superiority of even the present platinum masses over vanadium, a summary of which is presented later, should be remembered. Only a relatively small increase in the platinum content renders these platinized masses still more satisfactory.

It is suggested that an increase of only 50 per cent of that now being used would bring about the following results: (1) The life of the catalyst would be increased. (2) The catalyst would be rendered more satisfactory for the higher concentrations of gas which are being more and more frequently used. (3) Although the conversions at gas loadings now in use would not be appreciably affected, a greater platinum content would make it possible to obtain the same conversion at higher space velocities, a fact which is of considerable economic importance. (4) Conversions would not drop appreciably with high overloads. (5) Lower kindling temperature would result. (6) Temperature range over which high activity is obtained would be increased, thus simplifying plant control. (7) Gases with greater variability in sulphurs dioxide content could be satisfactorily handled.

As a result of these considerations, it can be seen that the total sulphur dioxide converted per cubic foot of catalyst during the period of its life would be increased, thus tending toward an actual reduction in the cost per ton of acid produced.

Because of the lack of sufficient data to appraise this increase in the quantity of sulphur dioxide converted,

**Table III—Catalyst Costs in Contact Sulphuric Acid Plants***

(Life of all catalysts assumed ten years; see discussion under Table I)

| | Platinized Magnesium Sulphate | Platinized (Pyrites) | Asbestos (Brimstone) | Platinized Silica Gel | Vanadium Catalysts — Mass A | Mass B | Mass C — Scheme I | Mass C — Scheme II |
|---|---|---|---|---|---|---|---|---|
| Platinum cost[1] | $240.00 | $274.80 | $219.60 | $84.80 | ..... | ..... | ..... | ..... |
| Carrier cost[1] | 60.00 | 50.00 | 50.00 | 242.50 | ..... | ..... | ..... | ..... |
| Miscellaneous costs[1] | 40.00 | 54.96 | 43.92 | 6.36 | ..... | ..... | ..... | ..... |
| Total initial catalyst cost[1] | 340.00 | 379.76 | 313.52 | 333.66 | $550.00 | $1,000.00 | $1,633.33 | $750.00 |
| Total initial catalyst cost[2] | 0.97 | 1.085 | 0.896 | 0.953 | 1.57 | 2.86 | 4.67 | 2.14 |
| Unrecovered catalyst cost[3] | 13.60 | 14.62 | 12.69 | 26.16 | 55.00 | 100.00 | 105.00 | 75.00 |
| Ultimate catalyst cost[4] | 34.00 | 37.41 | 31.50 | 46.18 | 88.00 | 160.00 | 115.50 | 120.00 |
| Ultimate catalyst cost per ton 100 per cent acid | 0.097 | 0.107 | 0.090 | 0.132 | 0.251 | 0.457 | 0.33 | 0.343 |

[1]Cost per daily ton of 100 per cent acid.
[2]Cost per annual ton of 100 per cent acid.
[3]Cost per daily ton of 100 per cent acid per year, including salvage credit.
[4]Cost per daily ton of 100 per cent acid per year, including salvage credit and charging 6 per cent on invested capital.

***Explanatory Notes**—Present price of platinum is taken as $40 per troy ounce.

No provision for catalyst regeneration or screening is made. In the case of a properly designed and operated plant, this should rarely be necessary and is better considered as an operating charge.

In salvaging platinum masses it is calculated that 15 per cent of all platinum used is lost in the recovery operations. From data at hand this allowance appears to be more than ample. Vanadium contact masses have no salvage value.

Vanadium mass *A* has been sold for about $550 per daily ton of 100 per cent acid. This figure is used in these calculations.

The scheme under which vanadium mass *B* has been sold calls for the payment of $1,000 per daily ton of acid capacity, the licensor furnishing the catalyst and relieving the purchaser of any further payment.

Vanadium mass *C* has been sold under two general schemes of payment. One, "Scheme I" in this table, calls for the purchase of the catalyst at a nominal figure per unit of volume and a further payment of a royalty of about 25c. per ton of acid. In order to make costs comparable to the costs of the other catalysts, the royalty fee must be considered as a capital charge and a capital reserve must be set up to pay for it. Consequently, in order to get the total initial cost, this capital reserve must be added to the nominal figure charged for the catalyst. Since this capital reserve is "recovered" at the time the catalyst is scrapped, it is to be considered in the same light as the salvaged platinum, and, consequently, costs are figured on that basis.

Scheme II, under which vanadium mass *C* has been sold calls for a single payment of $750 per daily ton of acid capacity, the licensor furnishing the catalyst and relieving the purchaser of any further payment.

**Discussion of Table III**—This table, with its explanatory notes, summarizes the data on catalyst costs. Only a superficial glance at the table is necessary to show that platinized contact masses are cheaper in every respect than the vanadium catalysts.

*Initial Cost of Catalysts*—The table shows that the total initial costs of the platinized catalysts are about on a par, platinized asbestos being slightly the cheapest when the basis is a 10 per cent-sulphur dioxide gas from brimstone. The initial cost of this contact mass for a 40-ton plant is about $12,540, whereas the corresponding figure for the majority of the plants of the same size using a vanadium mass has been $40,000. In the case of the former there is a large salvage value amounting to about 60 per cent of the initial cost, while there is none for the vanadium catalyst. Examination of the figures for total initial cost of catalyst per daily ton of 100 per cent acid shows that vanadium masses cost from 1.75 to 5.8 times as much as platinized asbestos.

*Cost of Catalysts Including Salvage Value*—Here platinized asbestos and platinized magnesium sulphate are about on a par, although the former is slightly cheaper when brimstone is the source of the gas. Platinized silica gel is somewhat higher, due to the fact that its salvage value is less, while the vanadium masses are from 4.3 to 8.3 times as expensive as the cheapest platinum catalyst.

*Ultimate Cost of Catalysts*—Considering all fixed costs directly chargeable against the catalyst per daily ton of 100 per cent acid per year (see second row from bottom), platinized asbestos and platinized magnesium sulphate are again about on a par, with platinized silica gel a little more costly and the vanadium catalysts several times as expensive. This row may be further interpreted as follows: the total cost in the case of platinized magnesium sulphate per daily ton of acid during its life of ten years would be $340, while the corresponding figure for vanadium mass *B* would be $1,600. In a 40-ton plant the saving in catalyst costs alone would amount to $30,400. A discussion of additional savings in plant and operation resulting from the use of platinized catalysts appears elsewhere.

The last row gives the ultimate cost of catalyst per ton of 100 per cent acid, allowing for salvage value and charging 6 per cent on invested capital. This includes all fixed charges and gives the cost which should be assessed against each ton of acid on account of the catalyst employed in the manufacture. As in the preceding paragraphs, the platinized catalysts are about on a par, platinized asbestos being the cheapest and silica gel the most expensive. The costs on the vanadium masses are considerably greater, being from 2.8 to 5.1 times as much as the platinized asbestos. The charge due to the use of vanadium mass *B* amounts to nearly 46c. per ton of acid produced.

it is impossible to calculate costs on this basis. However, the following discussion, which is based on the most unfavorable assumption—that is, no increase in the quantity of acid produced per cubic foot of catalyst—is of considerable interest as showing how slight the maximum advance of costs would be.

Calculations made on the same basis as those in Table III (platinum at $40 per troy ounce; 85 per cent recovery of the platinum content at conclusion of operations; 6 per cent interest on the investment in platinum; and a ten-year life of catalyst with 350 operating days per year) show that each ounce of platinum present per daily ton of acid means a cost of only 0.857c. per ton of acid produced. Hence, it can be readily computed that a 50 per cent increase in the platinum content of each of the catalysts given in the tables would cause, in the case of platinized magnesium sulphate, an advance in costs of only 2.6c. per ton of acid; with platinized asbestos and a pyrites gas, 2.9c.; with platinized asbestos and a brimstone gas, 2.4c.; and with platinized silica gel, an advance of only 0.9c. Even under the most adverse circumstances, which are contrary to what available evidence indicates, it can be seen that the costs would be far below those for the vanadium catalysts, and entirely justified on the basis of increased flexibility alone.

## Further Comparison of Catalysts

It is a well-known fact that under equilibrium conditions, and naturally independent of the catalyst or even of the use of one, maximum conversion in the system $SO_2$–$O_2$–$SO_3$ is obtained at approximately 400–425 deg. C. As the temperature increases (or decreases) the conversion at equilibrium decreases. However, as the temperature increases, the reaction velocity increases. As a result of these facts and the highly exothermic character of the $SO_2$-to-$SO_3$ reaction, conversion is almost universally accomplished in two stages. In the first stage about 70 to 80 per cent of the total conversion is effected with considerably less than half of the catalyst, the temperature of the exit gas depending on the type of converter, but frequently being 550 to 590 deg. C. In the second stage, after certain intermediate cooling, the remainder of the conversion is accomplished, the gases emerging at about 400–450 deg. C.

In regard to the relative effectiveness of the platinum and vanadium catalysts now in use for carrying out this conversion, experience demonstrates a number of interesting facts: Platinized catalysts have a lower kindling temperature. Temperature — $SO_2$ conversion curves show that platinized masses have greater activity over a much wider temperature range. Only at a certain narrow range (at which the equilibrium is not most satisfactory) and at moderate flow rates do the vanadium masses approach the platinum catalysts in activity. Furthermore, platinum masses excel in handling gases whose sulphur dioxide content varies from time to time. They are especially satisfactory for gases with low $SO_2$ content and, as pointed out earlier in this paper, are equally satisfactory for gases with a high percentage of $SO_2$. In addition, they permit higher gas loadings for conversions equal to vanadium and make greater overloads permissible.

*Poisoning of Catalysts*—The non-susceptibility of vanadium masses to poisoning by arsenic and other substances has been widely advertised. Under circumstances

prevailing hitherto in the usual sulphuric acid plant employing either platinized magnesium sulphate or platinized asbestos as the catalyst, removal of arsenic from the gas being treated has been considered necessary. It is quite a remarkable fact that the activity of platinized silica gel is not affected by the presence of arsenic in the gases, being similar in this respect to vanadium masses.

It should be emphasized at this point, however, that the subject of arsenic poisoning has not the prime importance it formerly had. A number of factors account for this. Improvements have been effected in gas-cleaning methods. Furthermore, in those cases where either pyrites or smelter gas is the source of the $SO_2$, if arsenic is not removed, neither are the dirt nor suspended matter entirely eliminated and accordingly the activity of the catalyst suffers no matter whether it is a vanadium or platinum mass. Similarly, engineering considerations such as the prevention of corrosion demand the removal of water vapor and sulphuric acid at some stage before conversion, and in the course of this the arsenic which is entrained in the mist is likewise largely removed.

The extensive use of brimstone as the source of the sulphur, having as it has a very low arsenic content, is another factor contributing to the decrease in importance of arsenic. Finally, the demand for an arsenic-free acid is steadily increasing and it is easier to purify the gas than the acid. If a good grade of acid is required there is no difference between the purification systems required in the case of the two catalysts. If an impure gas without purification is treated by a vanadium catalyst, the resulting acid, after suitable dilution, may be considered only as a competitor of chamber acid.

With brimstone as the source of the $SO_2$, there has been a marked tendency toward simplification of the purification system with the platinized catalysts as well as with the vanadium catalysts. In the scheme employed by the sponsors of the latter masses, the temperature of the gases previous to entering the contact material is at no time substantially lowered below the temperature required for operation of the first converter, the air for the burning being dried before combustion. It now appears that users of platinum catalysts can successfully employ similar much simplified systems of gas purification when brimstone is the source of the gas. In fact, one of the first patents involving such a scheme of operation was granted to a company which uses a platinum mass. Furthermore, it is understood that there is at least one plant in successful operation on this so-called "hot purification system" using a platinum mass. The success of such a scheme may be due in part to the method employed for melting and burning the brimstone as well as the fact that the temperature of the gases at all times is above the condensation points of substances other than the sulphur dioxide in the gas. Platinized silica gel is well adapted to simplified purification.

*Patent Situation*—In the case of the vanadium catalysts there has been some complication in connection with patents. The ultimate outcome, of course, is as yet unknown. It is expected that one suit will be brought to trial in the near future in the district court at Pittsburgh, Pa. However, there is no such complication in the case of the platinized masses, the basic patents with magnesium sulphate and asbestos as carriers having expired some time ago. It is understood that the manufacture and use of platinized silica gel is fully covered by patents. Its purchase carries with it the right to use.

*Engineering Features*—Engineering features with reference to the purification system required have already been discussed. In general, a platinized mass, because of the wide range of conditions over which highly satisfactory results are given, permits the use of the simplest type of converter. This reduces construction costs. Vanadium masses for most effective results require a converter in which temperatures must be closely controlled. Furthermore, because of the greater activity of the platinum masses, smaller units are required.

In the case of vanadium catalysts, because of their lesser activity, a high heat capacity of the mass is particularly desirable should there be interference with continuity of operation. Although this is not so essential in the case of platinized catalysts, fibrous asbestos is the only one that compares unfavorably.

### Comparative Costs of Plants

No exact figures are available as to capital costs of comparable plants using platinum and vanadium catalysts. In view of the already-discussed relative merits of the two, and on the basis of the latest developments in plant design, it would appear that for new plants designed to treat a 6–8 per cent gas derived from the burning of a sulphide ore, particularly when an arsenic-free acid is required, and for plants for the treatment of a 7–8 per cent gas from brimstone, construction costs slightly favor the plant using a platinized catalyst. Operating costs in these cases should be about the same. In the case of gases of greater concentration, toward which there is a marked trend, platinum is favored.

As far as catalyst costs themselves are concerned, this question has already been thoroughly presented in connection with Table III.* The savings due to the difference in catalysts alone are shown to amount to about 16–37c. per ton of acid produced, an economy well worth while in the case of this highly competitive acid, where profits are small. In this connection it should be pointed out that the biggest factor by far—and a relatively unchangeable one in the cost of sulphuric acid—is the expense for the sulphur-containing material. Therefore, in view of the limited savings possible, an economy such as the above is highly attractive.

However, the important economies resulting from the use of platinized catalysts are effected in the manner hereinafter described. It has already been emphasized that platinized catalysts, are splendidly adapted for use with all gases containing up to 10 per cent $SO_2$ or even more. On gases of high strength, vanadium masses have not given satisfaction, the gas requiring dilution before treatment. Hence, for only a slight increase, if any, in plant investment, one can secure a 25 to 40 per cent greater acid production with platinum masses than with vanadium. In view of the extensive present-day use of brimstone and the ease of producing a gas of any concentration desired therefrom, the above facts are of great importance. They mean a cut of from 20 to 28.5 per cent in capital cost per ton of acid.

It is also apparent that operating costs per ton of acid can be materially lower for the platinized catalyst than for vanadium, because a plant of the same size can produce 25 to 40 per cent more acid. The only additional expense of any importance would be that for the larger quantity of brimstone burned. As a result of the greater activity of the platinized catalysts, it is estimated that their use would cut total costs about $1 per ton of 100 per cent acid, a really remarkable saving, as can be seen from the brief discussion on costs that has been given. There would, of course, be a further saving in the lower cost of platinized masses.

# Applying Diffusion Calculations To Drying Porous Solids

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IN THE drying of porous solids by evaporation of the liquid from surfaces of solids, using air currents to effect the evaporation, Sherwood (*Ind. Engr. Chem.* Vol. 21, 12, 1929) has developed a theory, with experimental confirmation, showing three possible distinct stages in the drying process. Badger and McCabe (Elements of Chemical Engineering, McGraw-Hill, 1931) give a condensed discussion of this theory. The stages are shown graphically in an accompanying diagram and may be briefly distinguished as follows:

1. A constant drying rate period, during which the surfaces remain completely wet, the rate of evaporation being the same as that from a free liquid surface of constant area. Constant air velocity, direction, humidity, and temperature are assumed.

2. A first falling rate period, during which there is a falling off of wetted surface, the rate being directly proportional to the fraction of surface, which is wet. This rate may also be considered to be roughly proportional to the average liquid concentration in the solid. Plotting drying rate against average liquid concentration, as in Fig. 1, this falling rate period may be represented by a sloping straight line. This rate decreases linearly until the liquid concentration at the surface has reached equilibrium with the vapor concentration in the air and further decrease of concentration in the surface layer is not possible.

3. A second falling rate period, during which the liquid evaporates from the surface as fast as it can get there by diffusion from the interior of the solid. During this period the liquid concentration of the surface layer remains constant at the equilibrium value. The general shape of the curve for this stage is shown in Fig. 1.

In working out equations for the diffusion period, or second falling rate period, during the drying of the slab, some of Sherwood's assumptions are: (*a*) that the liquid concentration is uniform throughout the solid at the beginning of this stage; (*b*) that the evaporation takes place at the surface and that the surface resistance to vapor diffusion may be considered negligible; i.e., that the liquid concentration at the surface falls to the equilibrium value immediately at the start of this stage of the drying. In the following discussion,

$C$ = the liquid concentration in the solid at any location at any time, in pounds of liquid per cubic foot of solid; a variable with respect to time and location in the solid.

$C_o$ = the initial uniform liquid concentration, in the same units; a constant.

$C_1$ = the equilibrium liquid concentration, in the same units; a constant for air of constant humidity and temperature, as assumed in this paper.

$C - C_1$ = free liquid concentration at any point at any time.

$C_o - C_1$ = initial uniform free liquid concentration.

$\theta$ = time in hours.

$e$ = base of the natural system of logarithms.

$\exp x = e^x$

$k$ = diffusion constant, or diffusivity, in square feet per hour.

$W$ = average liquid concentration in the solid at any time; a variable with respect to time but not with respect to location in the solid.

$a$ = radius of a sphere or cylinder, the half-thickness of a slab, or the half-thickness of a rectangular shape in the x-direction, in feet.

$b, c$ = the half-thickness of a rectangular shape in the $y$- and $z$-directions, respectively, in feet.

If evaporation takes place only at the two opposite faces of the slab, the differential equation for diffusion is $\frac{\delta C}{\delta \theta} = k\frac{\delta^2 C}{\delta x^2}$, in which $x$ is the distance in the direction normal to the slab faces. If the mid-plane between the two faces is chosen as $x=o$, the solution of the differential equation is

$$\frac{C - C_1}{C_o - C_1} = \frac{4}{\pi}\left[\cos\frac{\pi x}{2a}\exp\left(-k\theta\left(\frac{\pi}{2a}\right)^2\right) - \frac{1}{3}\cos\frac{3\pi x}{2a}\exp\left(-9k\theta\left(\frac{\pi}{2a}\right)^2\right) + \frac{1}{5}\cos\frac{5\pi x}{2a}\exp\left(-25k\theta\left(\frac{\pi}{2a}\right)^2\right) - \right]$$

the right-hand side of which will be called Series A. By substituting any value of $x$ between $a$ and $-a$, any value of $\theta$, and the known value of $C_o - C_1$, a numerical value may be computed for the free liquid concentration, $C - C_1$, at the location and time so chosen. Ordinarily, it is more useful to know the average free liquid concentration throughout the slab at some desired time. This may be calculated by substituting for $\theta$ in the integrated equation

$$E_a = \frac{W - C_1}{C_o - C_1} = \frac{8}{\pi^2}\left[\exp\left(-\left(\frac{k\theta}{a^2}\right)\left(\frac{\pi}{2}\right)^2\right) + \frac{1}{9}\exp\left(-9\left(\frac{k\theta}{a^2}\right)\left(\frac{\pi}{2}\right)^2\right) + \frac{1}{25}\exp\left(-25\left(\frac{k\theta}{a^2}\right)\left(\frac{\pi}{2}\right)^2\right) + \cdots\cdots\right]$$

This equation is given by Sherwood and by Lederer (*Zeit. angew. Chem.* Vol. 37, p. 750, 1924), and the

Based on an interim paper of the American Institute of Chemical Engineers, dated Aug. 1, 1913.

right-hand side will be called Series A'. For any given slab thickness and diffusivity, the numerical values of $a$ and $k$ could be substituted in the equation, and it could be solved for $E_a$ by substituting various values of $\theta$. Thus a curve of $E_a$ vs. $\theta$ could be plotted for any particular slab thickness and diffusivity. However, a single curve which may be used for any diffusivity and slab thickness has been plotted as $E_a$ vs. $\frac{k\theta}{a^2}$. This is the upper curve of Fig. 2, and the data for constructing the curve are given in Table I.

If evaporation takes place only at the four long faces of a rectangular bar, the ends being sealed, the equation is $\frac{\delta C}{\delta \theta} = k\left(\frac{\delta^2 C}{\delta x^2} + \frac{\delta^2 C}{\delta y^2}\right)$. If the linear axis of the bar is taken as $x=o$ and $y=o$, it can be shown that

$$\frac{C-C_1}{C_o-C_1} = \text{(Series A) (Series B)}.$$

in which Series B is identical with Series A except for the substitution of $y$ for $x$ and $b$ for $a$. Using this equation by making proper numerical substitutions, one can calculate the concentration at any time and position in the bar. The average concentration throughout the bar at any time can be found by the use of the integrated equation given by Lederer and derived independently by the writer:

$$E = E_a E_b = \frac{W-C_1}{C_o-C_1} = \text{(Series A') (Series B')}.$$

By multiplying together the values of $E_a$ and $E_b$ read from the slab curve of Fig. 2, corresponding to the calculated values of $\frac{k\theta}{a^2}$ and $\frac{k\theta}{b^2}$, the value of $E$ for the bar is obtained. If the bar is made of laminated material and the different diffusivities in the $x$- and $y$- directions are known, these values may be substituted.

If evaporation takes place at all six faces of a rectangular parallelopiped (brick shape), the differential equation is $\frac{\delta C}{\delta \theta} = k\left(\frac{\delta^2 C}{\delta x^2} + \frac{\delta^2 C}{\delta y^2} + \frac{\delta^2 C}{\delta z^2}\right)$. If the center point of the shape is taken as the origin or coördinates, it can be shown that $\frac{C-C_1}{C_o-C_1}$=(Series A) (Series B) (Series C) in which Series C is identical with Series A except for the substitution of $z$ for $x$ and $C$ for $a$. Using this equation, one can calculate the concentration at any point in the shape at any time. The average concentration throughout the shape at any time can be found by use of the integrated equation

$E=E_aE_bE_c=\frac{W-C_1}{C_o-C_1}$ = (Series A') (Series B') (Series C'), also given by Lederer and derived independently by the writer. The value of $E$ is found by multiplying together the three $E$- values read from the slab curve.

The shapes considered in the foregoing treatment all had an even number of faces exposed to evaporation. In the case of the slab with only one face exposed, the bar with three faces exposed and the brick shape with five faces exposed, the average free liquid concentration at any time will be the same as that of the shape with twice the dimension normal to the protected surface and with the even number of faces exposed. Thus, for a slab with one face exposed, the average concentration at any time will be the same as that of a slab of twice the thickness but with both faces exposed.

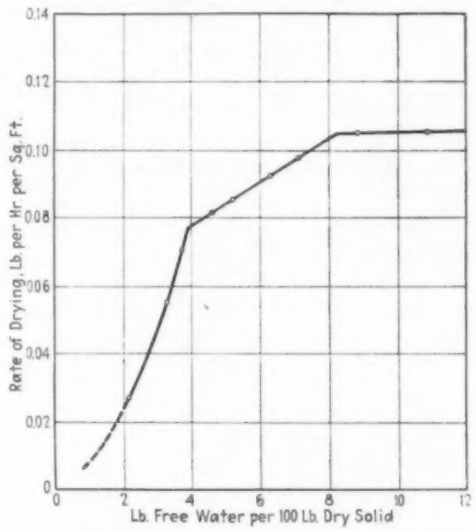



**Fig. 1—Diagram Showing the Stages of Drying (Badger and McCabe)**

Using polar coordinates, $r$ being distance from the center, the differential equation is $\frac{\delta C}{\delta \theta} = k\left(\frac{\delta^2 C}{\delta r^2} + \frac{2}{r}\frac{\delta C}{\delta r}\right)$. The radius of the outside of the sphere being $a$, the solution of this equation is

$$\frac{C-C_1}{C_o-C_1} = \frac{2a}{\pi r}\left[\sin\frac{\pi r}{a}\exp\left(-k\theta\left(\frac{\pi}{a}\right)^2\right) - \frac{1}{2}\sin\frac{2\pi r}{a}\exp\left(-4k\theta\left(\frac{\pi}{a}\right)^2\right) + \frac{1}{3}\sin\frac{3\pi r}{a}\exp\left(-9k\theta\left(\frac{\pi}{a}\right)^2\right) - \cdots\cdots\cdots\right]$$

the right-hand side of which will be called Series S. For

**Table I—Data for Constructing Curves on Fig. 2**

| | $E_{a,\,b,\,c}$ | $E_r$ | $E_s$ |
|---|---|---|---|
| $\frac{k\theta}{a^2}$ | Slab | Cylinder | Sphere |
| 0.005 | 0.922 | 0.843 | 0.774 |
| 0.01 | 0.890 | 0.784 | 0.690 |
| 0.02 | 0.839 | 0.698 | 0.579 |
| 0.03 | 0.805 | 0.640 | 0.500 |
| 0.04 | 0.773 | 0.588 | 0.440 |
| 0.05 | 0.749 | 0.548 | 0.396 |
| 0.06 | 0.725 | 0.512 | 0.352 |
| 0.08 | 0.680 | 0.450 | 0.280 |
| 0.10 | 0.643 | 0.394 | 0.226 |
| 0.15 | 0.562 | 0.292 | 0.139 |
| 0.20 | 0.497 | 0.219 | 0.084 |
| 0.25 | 0.440 | 0.168 | 0.052 |
| 0.30 | 0.388 | 0.122 | 0.031 |
| 0.40 | 0.298 | 0.0684 | 0.012 |
| 0.50 | 0.236 | 0.0384 | 0.0043 |
| 0.60 | 0.184 | 0.0215 | 0.0016 |
| 0.70 | 0.144 | 0.0121 | 0.0006 |
| 0.80 | 0.113 | 0.0068 | 0.0002 |
| 0.90 | 0.088 | 0.0040 | 0.0001 |
| 1.00 | 0.069 | 0.0021 | 0.0000 |
| 1.50 | 0.020 | 0.0001 | |
| 2.00 | 0.0058 | 0.0000 | |
| 3.00 | 0.0005 | | |

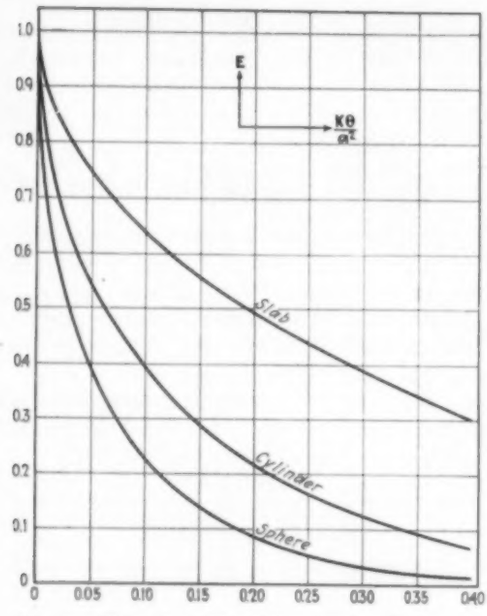



**Fig. 2—Chart for Calculating Drying Times for Different Shapes and Dimensions**

any particular radius, $r$, and time, $\theta$, the numerical values may be substituted, and the equation may be solved for a corresponding numerical value for the concentration. The average concentration at any desired time may be obtained by solving the integrated equation, given by Lederer, and derived independently by the writer:

$$E_s = \frac{W-C_1}{C_o-C_1} = \frac{6}{\pi^2}\left[\exp\left(-\left(\frac{k\theta}{a^2}\right)\pi^2\right)+\frac{1}{4}\exp\left(-4\left(\frac{k\theta}{a^2}\right)\pi^2\right)+\frac{1}{9}\exp\left(-9\left(\frac{k\theta}{a^2}\right)\pi^2\right)+\cdots\cdots\right]$$

the right-hand side of which will be called Series S′. By plotting $E_s$ against $\frac{a^2}{k\theta}$ in the case of the slab, the lowest curve in Fig. 2 is obtained and the numerical values for the construction of the curve are given in Table I.

For the case of the cylinder with evaporation only from the convex surface, the ends being sealed against evaporation, the differential equation is $\frac{\delta C}{\delta\theta} = k\left(\frac{\delta^2 C}{\delta r^2}+\frac{1}{r}\frac{\delta C}{\delta r}\right)$.

The solution of this equation leads to the use of Bessel functions, an explanation of which would require too much space for inclusion. Lederer suggests that the cylinder be treated as a rectangular bar with each side equal to the diameter of the cylinder, but this is obviously an approximation. The writer has derived the exact integrated equation for the cylinder:

$$E_r = \frac{W-C_1}{C_o-C_1} = 4\left[\frac{1}{R_1^2}\exp\left(-\left(\frac{k\theta}{a^2}\right)R_1^2\right)+\frac{1}{R_2^2}\exp\left(-\left(\frac{k\theta}{a^2}\right)R_2^2\right)+\cdots\cdots\right]$$

in which the $R$'s are the roots of the Bessel function $J_0(x)=O$. The first 40 $R$'s are given by Gray and Mathews (Treatise on Bessel Functions, 2d edition, MacMillian), but the first ten are sufficient for many purposes, and are given in Table II. The middle curve of Fig. 2 gives the values of $E_r$ corresponding to values of $\frac{k\theta}{a^2}$ in the above equation. The right-hand side of the above equation will be called Series R′.

For the case of the cylinder with evaporation at the convex surface and the two plane ends, the differential equation is $\frac{\delta C}{\delta\theta} = k\left(\frac{\delta^2 C}{\delta r^2}+\frac{1}{r}\frac{\delta C}{\delta r}+\frac{\delta^2 C}{\delta y^2}\right)$, in which $y$ is the distance along the axis. The integrated equation is

$$E = E_b E_r = \frac{W-C_1}{C_o-C_1} = (\text{Series B}')\ (\text{Series R}').$$

The value of $E$ is found by multiplying together the ordinates on the slab curve and cylinder curve corresponding to $\frac{k\theta}{b^2}$ for the $y$-direction and $\frac{k\theta}{a^2}$ for the radial direction, the proper values of $k$ and of the dimension being used. For the cylinder with convex surface and one end exposed, the average concentration at any time will be the same as that of a cylinder of twice the length but with both ends exposed.

A slab of brick clay 1 in. thick, with the four thin edges coated to prevent evaporation, and with the two large faces exposed, was dried by a current of air at room temperature. The initial moisture content was 27.3 per cent and the equilibrium moisture content was 3 per cent. The slab dried at a constant rate down to 16.5 per cent moisture. All percentages are on the wet basis. Analysis of the data showed that diffusion controlled the drying rate from 16.5 per cent to 3 per cent. In 254 minutes, the moisture content dropped from 16.5 per cent to 7.5 per cent. Under the same drying conditions, to what final average per cent moisture would the following shapes and sizes made up from the same clay dry in 40 hours, the initial moisture content being 16.5 per cent in each case?

(a) A brick shape, 9x4.5x2.5 in.?
(b) A solid sphere, 9 in. diameter?
(c) A solid cylinder, 9 in. diameter and 9 in. long, two ends and convex surface exposed?
(d) The same cylinder, with one end resting on an impervious surface, the convex surface and other end being exposed?

Equations and curves are worked out on the basis of concentrations expressed as weight of liquid per unit volume. In many cases, such as this example, it is more convenient to express concentrations as weight of liquid per unit weight of dry solid. If shrinkage is neglected, the weight of dry solid per unit volume will be the same at all stages of drying, and the ratio $E=\frac{W-C_1}{C_o-C_1}$ will be the same, whichever units are used, both numerator and denominator being effected to the same extent by the conversion factor. Badger and McCabe have utilized this idea in their slab problem. Taking the diffusion period of the slab experiment, and converting the moisture percentages to the basis of pounds of water per pound of dry clay,

Total initial moisture content = 16.5/83.5 = 0.1976
Total final moisture content = 7.5/92.5 = 0.0811
Equilibrium moisture content = 3/97 = 0.0309

$E=\frac{W-C_1}{C_o-C_1}=\frac{0.0811-0.0309}{0.1976-0.0309}=0.3$, and, from the slab

curve (Fig. 2) one finds, corresponding to $E=0.3$, $k\theta/a^2=0.4$, where $a$=half slab thickness, $\theta$=time in hours and $k$=diffusivity in square feet per hour. Substituting these values,

$$k=(0.4)\left(\frac{0.5}{12}\right)^2\left(\frac{60}{254}\right)=0.000164 \text{ ft.}^2/\text{hr.}$$

For the 40-hour drying periods proposed for the various shapes,

$k\theta=(0.000164)\ (40)=0.00656$

(a) In the case of the brick shape, the dimensions are 0.375x0.1875x0.10417 ft.

$$\frac{k\theta}{a^2}=\frac{0.00656}{(0.375)^2}=0.0467; \quad E_a=0.76 \text{ (from chart)}$$

$$\frac{k\theta}{b^2}=\frac{0.00656}{(0.1875)^2}=0.1865; \quad E_b=0.51$$

$$\frac{k\theta}{C^2}=\frac{0.00656}{(0.10417)^2}=0.6045; E_c=0.18$$

For the brick shape,

$E=E_aE_bE_c=(0.76)\ (0.51)\ (0.18)=0.07$,

and since

$$E=\frac{W-C_1}{C_o-C_1}=\frac{W-C_1}{(0.1976-0.0309)}=0.07$$

$W=C_1+0.07\ (0.1667)\ =0.0309+0.0117=0.0426$

$$\frac{1.0426}{1.0426}=0.4086 \text{ or } 4.086 \text{ per cent final average moisture.}$$

(b) In the case of the solid sphere, $a=4.5/12=0.375$ ft.

$$\frac{k\theta}{a^2}=\frac{0.00656}{(0.375)^2}=0.0467; E_r=0.42 \text{ (from chart)}$$

$W=C_1+0.42\ (0.1667)=0.0309+0.0700=0.1009$

$$\frac{0.1009}{1.1009}=0.0916 \text{ or } 9.16 \text{ per cent final average moisture.}$$

(c) In the case of the solid cylinder with all surfaces exposed,

$a$=radius $=4.5/12=0.375$ ft.

$b$=half length $=4.5/12=0.375$ ft.

$$\frac{k\theta}{a^2}=\frac{k\theta}{b^2}=0.0467$$

Corresponding to this abscissa, we read off the ordinates on the cylinder curve and the slab curve, respectively, and find $E_r=0.56$;

**Table II—Roots of Bessel Function $Jo(x)=0$**

| $n$ | $R_n$ | $n$ | $R_n$ |
|---|---|---|---|
| 1 | 2.4048 | 6 | 18.0711 |
| 2 | 5.5201 | 7 | 21.2116 |
| 3 | 8.6537 | 8 | 24.3525 |
| 4 | 11.7915 | 9 | 27.4935 |
| 5 | 14.9309 | 10 | 30.6346 |

$E_b=0.76$; and, since $E_b=E_rE=(0.56)\ (0.76)=0.426$,

$W=C_1+0.426\ (0.1667)=0.0309+0.0710=0.1019$

$$\frac{0.1019}{1.1019}=0.0925 \text{ or } 9.25 \text{ per cent final average moisture.}$$

(d) In the solid cylinder, with one end protected, the final average moisture percentage will be the same as that of a cylinder of twice the length, but with all surfaces exposed, or $b=0.75$ ft. Following the same procedure as under ($c$), one finds

$E=E_rE_b=(0.56)\ (0.89)=0.498$

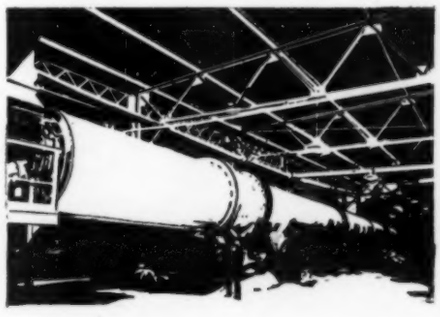
$W=0.1139$, giving 10.22 per cent final average moisture.

A simple change of definitions makes all of the foregoing equations directly applicable to problems of temperature distribution and average temperature in bodies of the shapes considered. The cases of temperature distribution have been completely presented by Williamson and Adams (*Phys. Rev.* Vol. 14, p. 99, 1919). The new definitions are:

$c$ = temperature at any location at any time.
$c_o$ = initial uniform temperature.
$c_1$ = new temperature at the exposed surfaces.
$w$ = average temperature at any time.
$C$ = mean specific heat over the temperature range.
$D$ = density of the solid.
$K$ = mean thermal conductivity of the solid.
$k=\frac{K}{CD}$ = thermal diffusivity = area/time.

Inasmuch as the ratios used in the equations involve temperature differences, any temperature scale may be chosen as long as consistent units are used throughout.

The new equations for determining average temperatures may find direct application in the heating and cooling operations of heat-treatment of metals and alloys. It should be noted that the equations can be used either for cooling or for heating. In other works, $c_1$ can be either greater or smaller than $c_o$ and the values of $c$ and $w$ will adjust themselves accordingly. Inasmuch as the resistance due to surface films is not considered in the mathematical derivations, the equations should be used only for purposes of approximation; there are no physical means of maintaining a solid surface at precisely a given temperature while the other parts of the solid are varying in temperature.



# Electrolytic Hydrogen With the Pechkranz Electrolyzer

By R. T. ELWORTHY

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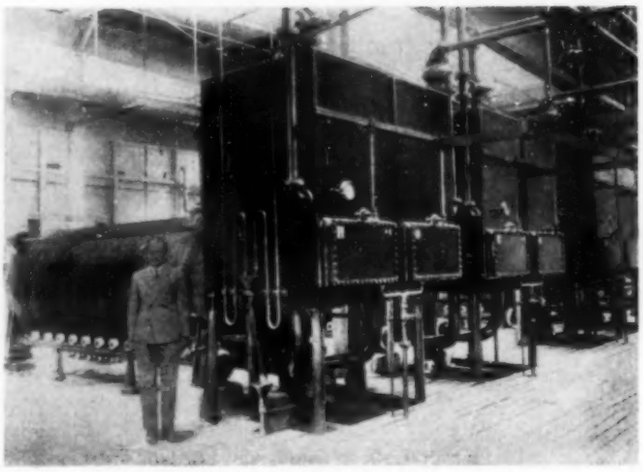
DURING the last decade, one of the outstanding features in chemical technology has been the development of processes involving gaseous reactions. The manufacture of synthetic ammonia and of synthetic alcohols, and the production of hydrogenated fats and oils have become major industries. In all these processes hydrogen constitutes one of the most important materials.

Although there are many methods of producing hydrogen, greatly varying in cost, purification usually is essential, and what is gained by lost cost production generally is lost in the expense of purification. The production of hydrogen by electrolysis is the only method in which purification is not necessary, as gas analyzing 99.5 to 99.9 per cent hydrogen is readily obtained.

Although the electrolysis of water as a means of obtaining oxygen and hydrogen has been established on a commercial basis for many years, there have been few outstanding improvements in apparatus since the early cells of Garuti and Pompili, Schuckert, and the International Oxygen Co. Most of the original commercial cells were of the filter-press type, but this form has been superseded in recent years by the tank-type cell. However, the filter-press type cell has many advantages and the most widely employed electrolytic oxy-hydrogen generator in Europe today—the Pechkranz electrolyzer —is of this type. The main objections to the older filter-press electrolyzers were the difficulty in preventing leakage of electrolyte and the greater trouble in dismantling to replace defective diaphragms. These troubles have been rendered non-existent in the Pechkranz electrolyzer, on account of the employment of perforated nickel sheet diaphragms in place of asbestos and because of the efficient method of packing adopted.

**Battery of Pechkranz Electrolyzers Showing Filter-Press-Type Construction**



**Battery of Pechkranz Electrolyzers From Reservoir End**

### Electrolyzer Construction

Pechkranz electrolyzers somewhat resemble large filter presses, as will be evident from the illustrations. They consist essentially of a series of cells, each formed by two circular electrodes separated by a porous diaphragm cemented in a circular frame. The several electrodes and diaphragm frames are bolted up tightly between two strong cast-iron end plates which themselves constitute the end electrodes. The main support of the apparatus is formed by the base of the end plates, while further support is given by a certain number of the electrodes which bear by means of insulated rollers on the lower tierods. At one end of the unit are two reservoirs in which the oxygen and hydrogen are separated from the foam of electrolyte. Here the gases are washed, distilled water is added to the electrolyte, and the electrolyte is cooled prior to recirculation.

The electrodes usually are about 6 ft. in diameter and an electrolyzer consisting of, say, 110 cells is about 25 ft. long. Its weight empty is about 30 tons.

Electrodes are made of sheet iron, thickly nickel plated on the anode side. At the top are two holes coinciding with two similar holes in the diaphragm frames. When the electrodes and diaphragms are pressed together, these holes form channels running the length of the electrolyzer, one carrying off hydrogen and the other oxygen to the respective gas washers. Corresponding openings in the bottom of the electrodes allow for the return circulation of the electrolyte.

One of the special features of the Pechkranz electrolyzer is the employment of a metallic diaphragm, composed of a sheet of pure nickel perforated with exceedingly fine holes, less than 0.004 in. in diameter. There are 5,000 to 6,000 perforations per square inch. These diaphragms, made by a special process, are strengthened by a number of crossbars attached with pure nickel rivets, and are cemented in circular iron frames. They are absolutely proof against deterioration or attack by hot alkali and, unlike asbestos diaphragms, which swell and thicken after a time, their porosity increases with use. The nickel sheet itself takes no part in the passage of the current, which is conducted solely through the columns of electrolyte filling the perforations.

Packing between the electrodes and the diaphragm frames is composed of plaited mineral fibers impregnated with a special unsaponifiable hydrocarbon. Leakage of electrolyte, which has hitherto been a constant nuisance in filter-press type cells, is entirely absent.

### Reservoir Construction

The two reservoirs placed at one end of the cells are made of welded iron plate and each consists of three sections, including the gas separator, gas washer, and electrolyte cooler. Each reservoir is about 6 ft. in height, 5 ft. wide, and 4 ft. in breadth, standing 5 ft. from the ground level. The foam of electrolyte and gas passes from the collecting pipes into the middle section, where the gas separates and bubbles up through distilled water in the top section, By this means all traces of electrolyte are removed. The electrolyte runs into the lower section, where it is cooled by contact with a bank of pipes through which cooling water is circulated. It then passes back to the cells. The distilled water drops into the electrolyte and the washed gases pass out through the delivery pipes and are conveyed to the point of use.

As the electrolyte has the optimum conductivity at about 80 deg. C., the apparatus yields its best output at this temperature. This is readily controlled by means of the cooler and makes for great flexibility in operation. A supply of warm water from the cooler also is made available for heating buildings or for supplying the distilled water apparatus. The make-up water is provided as a constant stream of distilled water flowing into the washer. The maximum distilled-water consumption is 7.5 gal. per 1,000 cu.ft. of hydrogen, and it frequently approximates in practice the theoretical consumption of 5.0 gal.

The reservoirs are grounded and there is no possibility of electrolyte corrosion in the tanks or piping. The gases also leave the apparatus at earth potential, thus avoiding any possibility of ignition even if the gases were mixed.

A solution of 25-per cent caustic potash in distilled water is employed as electrolyte. Potash is chosen in preference to caustic soda, on account of its higher conductivity, especially at low temperatures. The electrolyzers, therefore, take up their normal charge much more rapidly after a long shutdown, during which the electrolyte has become quite cold.

Because of the small size of the Pechkranz electrolyzer, as compared with tank-type cells of equivalent output, the saving in cost of potash for the initial filling is considerable. The loss from leakage is nil and the loss by formation of carbonate is practically negligible, since the electrolyte does not come in contact with air, as it does in a tank-type cell.

Purity of the hydrogen produced is 99.5 to 99.9 per cent, and of the oxygen 98.5 to 99.0 per cent, without any further purification process.

### Electrical Characteristics

Pechkranz electrolyzers can be operated at from 2 to 2.5 volts per cell, and up to 150 cells can be built up in one electrolyzer. Units can be connected in series or in parallel, depending on the voltage and source of supply of the direct current. For small installations motor generators are commonly used, while mercury-arc rectifiers have proved satisfactory where large blocks of power are available and a number of electrolyzers are installed. Thus two units of 140 cells each in series can take 700 volts and up to 2,500 amp. Each unit will absorb 875 kw. and yield over 5,500 cu.ft. of hydrogen per hour, measured at 20 deg. C. and 760 mm. pressure.

On account of the great flexibility of the Pechkranz electrolyzer, it is possible to supply batteries working at very different efficiencies. The cost of a unit naturally is related to the number of cells making up the unit. Where power is expensive, it is better to install an electrolyzer, or a battery of electrolyzers, with a high output—for example with a consumption of 127 to 140 kw. per 1,000 cu.ft. of hydrogen. The initial cost will be greater but the operation costs will be less than with higher power consumption. On the contrary where power is cheap, an electrolyzer consuming 150 to 170 kw. per 1,000 cu.ft. of hydrogen should be selected.

The number of working hours per annum also is an important factor in the choice of the most suitable installation. The most economical solution is furnished by choosing an installation for which the sum of the amortization charges and the annual power cost is the lowest.

Another advantage of the Pechkranz electrolyzer is that even if a high-efficiency unit is installed, and for some reason it is desired to augment the hydrogen output, the electrolyzer can be overloaded up to 70 per cent or more without harm.

There are still other features which make for low operating costs and low fixed charges. The floor space occupied by a battery of Pechkranz electrolyzers is several times smaller than that required for an equivalent installation of tank-type cells. Together with ample allowance for passageways, the space required is about 65 sq.ft.per 100 kw. Substantially constructed buildings are not essential, for, on account of the small cooling surface, the surrounding air temperature is not an important factor in operating efficiency. Because of compactness and ease of operation, supervision is reduced to a minimum and one man can easily control 40 to 50 electrolyzers.

### Installations

There are a number of installations of Pechkranz electrolyzers in Europe, all of which have been successfully operating for several years. The most noteworthy installation is that at Notodden, in Norway. It comprises over 300 electrolyzers, absorbing altogether about 108,000 kw. These are erected in a six-story building, each floor of which has an area of only 21,000 sq.ft. and contains 48 to 54 electrolyzers.

During the last year an installation of Pechkranz electrolyzers has been erected at the large synthetic ammonia plant of the Consolidated Mining & Smelting Co. This battery of 14 units is capable of absorbing 6,500 kw. Other smaller installations are now in course of erection or under consideration

# The Railroads' Problem— Is There an Engineering Solution?

By CHARLES W. CUNO

*Consulting Chemical and Metallurgical Engineer*
*Industrial Bureau, Industrial Club of St. Louis*

**Process industries must pay at least $50,000,000 a year, or 40 per cent of the $125,000,000 promised to the railroads under the original plan proposed by the Interstate Commerce Commission. Petroleum, coal and coke, ores and concentrates, pulpwood, phosphate, sulphur, and fertilizers must carry the brunt of this penalty for inefficiency on the part of some of the carriers. To find out what this is going to mean to our industries—and to the railroads themselves—is the purpose underlying Dr. Cuno's study and appraisal of this whole situation.—*The Editor.***

BY ITS RECENT DECISION the Interstate Commerce Commission shows a manifest desire to solve at least partially the situation for the railroads and at the same time satisfy as great a part of the public as possible—but nothing more. It is truly a compromise measure, admittedly of a temporary nature.

In exempting farm staples and placing the burden almost entirely on industrial raw materials[1] and finished products it leaves us with the unsatisfied impression that nothing constructive has been accomplished, that the increases made are still based on the fundamental fallacy, "what the traffic will bear," and that the railroad problem has still to be solved.

The situation also brings to light that which we have suspected for a long time, which is that railroads in the mad scramble for "tonnage" have been hauling some classes of freight at a loss. We can even go further and state without much fear of contradiction that the greater part of this unprofitable traffic has arisen through the scramble for tonnage in competition with other common carriers such as steamships, lake and river carriers. A reasonable cooperation with other forms of conveyance (as has been forced on the railroads by the Dennison bill) has demonstrated that such rail-river traffic has resulted in greater net profit to the railroads, due to increased profitable tonnage and partial transfer of unprofitable tonnage to barge lines, where it belongs.

No doubt, under present conditions the majority of railroads have not made sufficient profit, but the only two remedies that their executives seem to consider are either a rise in rates or a cut in wages. Perhaps a larger percentage of railroad revenue goes to wages and salary than in any other industry; certainly a consideration of safety and efficiency hardly warrant any further reduction in equipment costs.

The effects of a reduction in wages can be predicted. They involve such problems as reduction in efficiency, dissatisfaction among employees and even strikes with their accompanying hazards, loss in time and destruction of property.

WHAT, on the other hand, will be the effect of any rise in freight rates? Railroad freight revenue may be roughly divided into two groups: local, short haul or intrastate, and long haul or interstate. The first class is fast disappearing because of truck competition. Many railroads have already lost to trucking companies from 50 to 75 per cent of this lucrative form of traffic. The reasons for this are: (1) factory to store-door delivery, (2) a saving of time on account of delays caused by switching at both ends of railroad, and (3) in most cases a saving of one-third to one-half the cost of transportation. It is reasonable to suppose that 6 to 10 per cent increase in this class of rates would tend to throw an additional 20 to 30 per cent of this short-haul traffic to the trucks. As road building has progressed and truck operation has become more efficient the radius of regular truck service on practically express schedule has increased from 25 miles in 1925 to 150 in 1931.

The long haul of the railroads has had competition chiefly from river, lake, and ocean carriage. That this competition has been material can be seen by the following facts: (1) that in normal times over 55,000,000 tons of iron ore alone is handled by the Great Lakes steamships even in a single season; (2) that nearly 33,000,000 tons of ore and fuel is handled on the Allegheny and Monongahela rivers to serve the Pittsburgh district, and (3) that the Mississippi River barge traffic continues to grow. Practically all of the greater industrial cities of the United States are either seaports on the Atlantic or Pacific ocean, lake ports on the Great Lakes, or river ports on the greater Mississippi waterways.

As long as freight rates are made on the basis of "what the traffic will bear" instead of cost per ton mile, there will continue to be dissatisfaction among shippers and an endeavor to better these arbitrary rates by other means of transportation. If, on the other hand, railroads cannot transport commodities more efficiently[2] than any other form of transportation, *then there exists no further excuse for their operation.* On this question the Commission comments pointedly as follows:

> But in this instance the distrust in railroad securities inspired by the effects of depression has been much accentuated by the rather sudden awakening to the fact that the railroads are now faced by serious competition from other largely *new* and *developing* means of transportation.

Again:

> However sympathetic one may be with the plight of the railroads and their need for additional revenue, such sympathy can-

[1] For a complete list see *Chem. & Met.*, page 675, November, 1931.

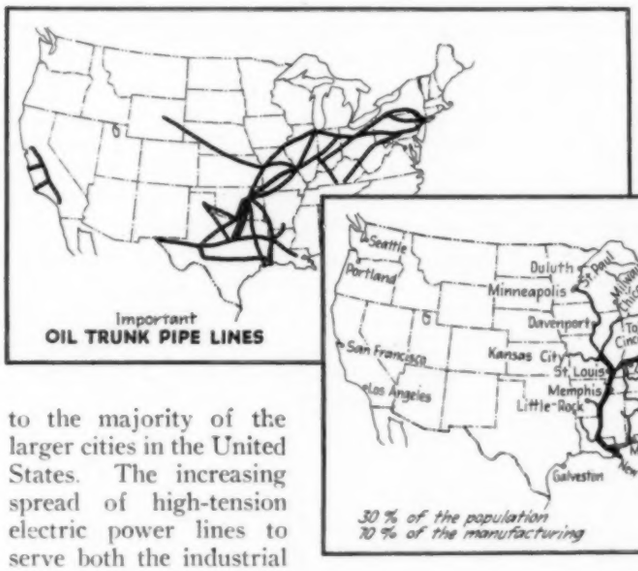
[2] The factors of efficiency in railroad freight transportation are cost, time, and care in handling. On the other hand, in passenger transportation they may be stated as cost, time, comfort, and safety.

not with benefit to anyone be carried out to the point of a refusal to recognize and face facts. The facts set forth show beyond question that there are elements of plain peril to the railroads in such an increase in freight rates as they propose at the present time.

The chief dangers are that at a time when transportation costs are of vital consequence to every industry it will *stimulate new competitive forces already rapidly* developing; that it will alienate or impair the friendly feeling toward the railroads on the part of the people of the country which is essential to adequate legislation for their protection, and the proper regulation of all forms of transportation in the public interest, and that it will disturb business conditions in an already shell-shocked industry, and *accelerate the tendency toward a localization of production.*

The industrialist divides railroad freight transportation into transportation of fuel, transportation of raw materials, and transportation of finished products. By such a classification we can readily visualize the inroads that other forms of transportation have already made on each class.

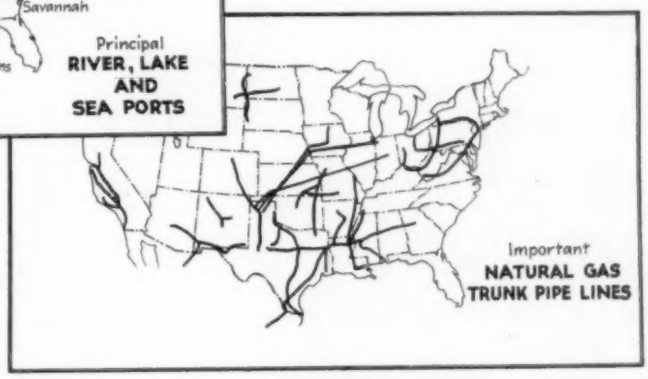
WELL-DISTRIBUTED coal areas in the United States have shortened considerably the average haul to consuming centers. Over three-fourths of the cities above the 100,000 class have coal rates of less than $1 per ton from the nearest source of fuel. About 97,000 miles of pipe lines, about one-half of which are major trunk lines, transport crude oil, gasoline, and natural gas to the majority of the larger cities in the United States. The increasing spread of high-tension electric power lines to serve both the industrial and domestic demand for power has replaced the use of some 65,000,000 tons of transported coal per year.



In chemical and metallurgical industries we see increasing use of ocean, lake, and barge-line service in the transportation of such raw materials as iron ore, pyrite, bauxite, barytes, gypsum, sulphur, etc., the total yearly tonnage being well over 100,000,000. Many of the large companies have seen fit to operate their own steamship and barge-line equipment for more economical long hauls. On short haulage also, many companies operate their own railroads from source of raw material to plant. In some of the mining districts even the above-ground steam rail haulage has been abandoned for underground electric haulage, the claim being that this is more economical. In one such company alone the tonnage thus diverted from railroad haulage amounts to 5,000,000 yearly. An increase of 6 to 10 per cent on the present rates for hauling fuels will, therefore, tend only to increased use of oil, gas, and electric power.

In the transportation of finished products, we likewise must see a number of changes, all of which make for ultimate reduction of the revenue to the railroads. The trend to decentralization of industry, already well started, will receive an added impetus with greater freight differentials between points of production and consumption. New plants will spring up. Locations which formerly found themselves unable to compete will find that a 10 per cent increase in freight will put them in the running. The result: shorter hauls and less haulage for the railroads.

Restating the situation in a more abstract way, three values are added to raw material in its travel to the consumer in the form of finished product. The first of these may be called *form value,* in which labor, power, and machinery actually transform the raw material or materials into finished products. The second may be termed *place value,* such as the services performed by the railroads, trucks, steamships, barges, pipe lines, electric lines, etc., in transporting all material from the place of origin to the point of consumption. The third is *time value,* such services as are performed by storage and warehousing companies, brokerage houses, jobbers and even the retailer who spreads, for instance, your yearly consumption of 100 lb. of butter over 52 weeks. It is clearly evident that the last two are not fundamental to the actual production or form value, and any curtailment of the actual cost put upon the goods because of such services, does not decrease its actual (or social) value to the consumer. Conversely, any increase in labor, power, or machinery put on raw material may better the form value of any article and enhance its real value to the consumer, but an increase of distance between the origin of goods and the consumer (a 6 to 10 per cent increase in tariff means, of course, 6 to 10 per cent increase in distance) increases the place value of the commodity, but does not increase its real or social value. The same may be said of time value.




In spite of the disappointing elements in the decision as handed down by the Interstate Commerce Commission, we believe that the railroad problem can and will be solved. In justice we cannot concede to the railroads the right to a just return on their investments except on the same terms meted out to industries in general, which is only after applied engineering practice pronounces on the efficiency of the undertaking and its soundness from an engineering standpoint. Which means, concretely, a proper increment not on freight rates made according to "what the traffic will bear" but on costs per ton-mile.

# Solving Relative-Absolute Humidity Conversions

By A. J. MONACK

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IN THOSE INDUSTRIES which employ humidity measurements there are two ways of expressing the quantity of moisture contained in air. Air conditioning engineers generally use the term, per cent relative humidity, which is the ratio of the actual weight of water vapor carried by a cubic foot of air, to the quantity carried by the same volume of saturated air at the same temperature. Engineers in ceramic and other chemical engineering industries very frequently use the somewhat more logical expression, per cent absolute humidity, which is the ratio of the weight of water actually carried by a pound of *dry* air at a given temperature, to the weight carried by a pound of dry air *when saturated* at the same temperature.

It is possible to convert one set of units to the other, but a troublesome calculation is involved. Lavine and Sutherland (*Chem. & Met.*, July, 1929, p. 426) have presented a conversion chart which is not entirely satisfactory, since a subtraction must be performed in its use. The need for a more convenient chart led to the one given here.

Per cent relative humidity, $R$, may be converted to per cent absolute humidity, $H$, by means of the formula:

$$H = \frac{29.92 - p}{29.92 - \frac{R}{100} p} R \qquad (1)$$

where $p$ is the partial pressure of water vapor in a saturated mixture at a given temperature. To convert per cent absolute humidity, $H$, to per cent relative humidity, $R$, formula (1) is solved for $R$ and written in the form

$$R = \frac{29.92}{29.92 - \left(1 - \frac{H}{100}\right) p} H \qquad (2)$$

Use of these formulas is entirely satisfactory for occasional conversions, but very inconvenient for routine calculations. A graph of per cent relative humidity vs. per cent absolute humidity at various temperatures was found to be of very limited value. Lines corresponding to temperatures between 32 deg. and 150 deg. F. are too close together for accurate use, and such a chart assumes immense proportions if a sufficiently large scale is used in plotting.

It was necessary, therefore, to devise another method of plotting and it appeared that a graph of either relative or absolute humidity against temperature would give a satisfactorily open chart for ready use. Before attempting to plot a chart it was desirable to find what the effect on $H$ and $R$ would be when the temperature was made 212 deg. In this case $p$ becomes 29.92, and when this is substituted in the first equation and $R$ is made equal to 100 per cent, the value of $H$ becomes indeterminate. When $R$ is equal to 100—$\Delta$, with $\Delta$ always positive, substitution in equation (1) shows that for any value of $R$ except 100 per cent, $H$ will always be zero at 212 deg.

Using the second equation at 212 deg., with $H$ equal to 100 per cent, we find $R$ equal to 100 per cent; and when $H$ is any per cent less than 100, for instance

**Table I—Conversion of Per Cent Relative to Per Cent Absolute Humidity**

| Per Cent Relative Humidity | Per Cent Absolute Humidity | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 32° F. | 75° F. | 100° F. | 140° F. | 150° F. | 160° F. | 170° F. | 180° F. | 190° F. | 200° F. | 205° F. | 210° F. |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 5.0 | 4.9 | 4.7 | 4.1 | | 3.4 | | 2.5 | | 1.2 | | |
| 10 | 9.9 | 9.8 | 9.4 | 8.2 | 7.7 | 7.0 | 6.1 | 5.1 | 3.8 | 2.3 | 1.4 | 0.4 |
| 15 | 14.9 | 14.6 | 14.1 | 12.4 | | 10.6 | | 7.9 | | 3.6 | | |
| 20 | 19.9 | 19.6 | 19.0 | 16.8 | 15.7 | 14.4 | 12.8 | 10.8 | 8.2 | 5.1 | 3.1 | 0.8 |
| 25 | 24.9 | 24.5 | 23.7 | 21.1 | | 18.3 | | 13.9 | | 6.7 | | |
| 30 | 29.8 | 29.4 | 28.6 | 25.6 | 24.2 | 22.4 | 20.2 | 17.2 | 13.3 | 8.4 | 5.1 | 1.4 |
| 35 | 34.8 | 34.4 | 33.4 | 30.2 | | 26.6 | | 20.8 | | 10.4 | | |
| 40 | 39.8 | 39.4 | 38.4 | 34.9 | 33.2 | 31.1 | 28.2 | 24.4 | 19.3 | 12.5 | 7.8 | 2.1 |
| 45 | 44.8 | 44.2 | 43.3 | 39.6 | | 35.5 | | 28.4 | | 14.9 | | |
| 50 | 49.8 | 49.4 | 48.4 | 44.6 | 42.7 | 40.3 | 37.1 | 32.7 | 26.7 | 17.7 | 11.2 | 3.1 |
| 55 | 54.8 | 54.3 | 53.2 | 49.6 | | 45.1 | | 37.3 | | 20.8 | | |
| 60 | 59.8 | 59.4 | 58.4 | 54.6 | 52.8 | 50.2 | 47.0 | 42.2 | 35.0 | 24.3 | 15.9 | 4.6 |
| 65 | 64.8 | 64.3 | 63.3 | 59.8 | | 55.4 | | 47.4 | | 28.5 | | |
| 70 | 69.8 | 69.6 | 68.6 | 65.3 | 63.4 | 61.3 | 57.9 | 53.2 | 45.7 | 33.4 | 22.7 | 7.4 |
| 75 | 74.8 | 74.5 | 73.5 | 70.7 | | 66.8 | | 59.3 | | 39.2 | | |
| 80 | 79.8 | 79.7 | 79.0 | 76.4 | 74.7 | 73.1 | 70.2 | 66.0 | 58.9 | 46.1 | 33.4 | 12.0 |
| 85 | 84.9 | 84.7 | 83.9 | 82.2 | | 78.9 | | 73.5 | | 54.9 | | |
| 90 | 90.0 | 89.9 | 89.6 | 87.9 | 86.8 | 85.8 | 84.2 | 81.4 | 76.2 | 65.8 | 53.3 | 23.0 |
| 95 | 95.0 | 94.9 | 94.5 | 94.0 | | 92.5 | | 90.3 | | 80.3 | | 36.4 |
| 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

**Table II—Conversion of Per Cent Absolute to Per Cent Relative Humidity**

| Per Cent Absolute Humidity | Per Cent Relative Humidity | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 32°F. | 75° F. | 100° F. | 140° F. | 160° F. | 180° F. | 200° F. | 205° F. | 210° F. |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 5 | 5.0 | 5.1 | 5.5 | 6.0 | 7.5 | 9.7 | 19.7 | | 63.4 |
| 10 | 10.0 | 10.1 | 10.4 | 12.1 | 14.2 | 18.6 | 34.2 | 46.7 | 76.6 |
| 15 | 15.1 | 15.3 | 16.1 | 17.8 | 21.1 | 26.5 | 45.1 | | |
| 20 | 20.2 | 20.3 | 21.0 | 23.6 | 26.9 | 34.0 | 53.9 | 66.6 | 88.0 |
| 25 | 25.2 | 25.5 | 26.5 | 29.3 | 33.2 | 40.7 | 60.8 | | |
| 30 | 30.2 | 30.4 | 31.4 | 34.7 | 38.7 | 46.8 | 66.6 | 77.3 | 92.6 |
| 35 | 35.2 | 35.7 | 36.7 | 40.2 | 44.6 | 52.6 | 71.5 | | |
| 40 | 40.2 | 40.6 | 41.6 | 45.4 | 49.8 | 57.8 | 75.7 | 84.1 | 95.4 |
| 45 | 45.2 | 45.7 | 46.8 | 50.4 | 54.9 | 62.7 | 79.2 | | |
| 50 | 50.2 | 50.6 | 51.6 | 55.4 | 59.7 | 67.3 | 82.3 | 88.8 | 96.9 |
| 55 | 55.2 | 55.8 | 56.7 | 60.4 | 64.5 | 71.6 | 85.1 | | |
| 60 | 60.2 | 60.6 | 61.6 | 65.1 | 68.9 | 75.6 | 87.5 | 92.2 | 97.9 |
| 65 | 65.2 | 65.6 | 66.6 | 69.8 | 73.4 | 79.2 | 89.6 | | |
| 70 | 70.2 | 70.6 | 71.4 | 74.4 | 77.6 | 82.8 | 91.6 | 94.9 | 98.6 |
| 75 | 75.1 | 75.5 | 76.3 | 78.9 | 81.7 | 86.1 | 93.3 | | |
| 80 | 80.1 | 80.4 | 81.0 | 83.2 | 85.6 | 89.2 | 94.9 | 96.9 | 99.2 |
| 85 | 85.1 | 85.4 | 85.9 | 87.6 | 89.4 | 92.1 | 96.4 | | |
| 90 | 90.1 | 90.2 | 90.6 | 91.8 | 93.0 | 94.9 | 97.7 | 98.6 | 99.6 |
| 95 | 95.0 | 95.1 | 95.3 | 95.9 | 96.6 | 97.5 | 98.8 | | |
| 100 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

100—Δ (Δ always greater than zero), $R$ is again 100 per cent. Hence for all values of $H$, $R$ will remain equal to 100 per cent at 212 deg. F.

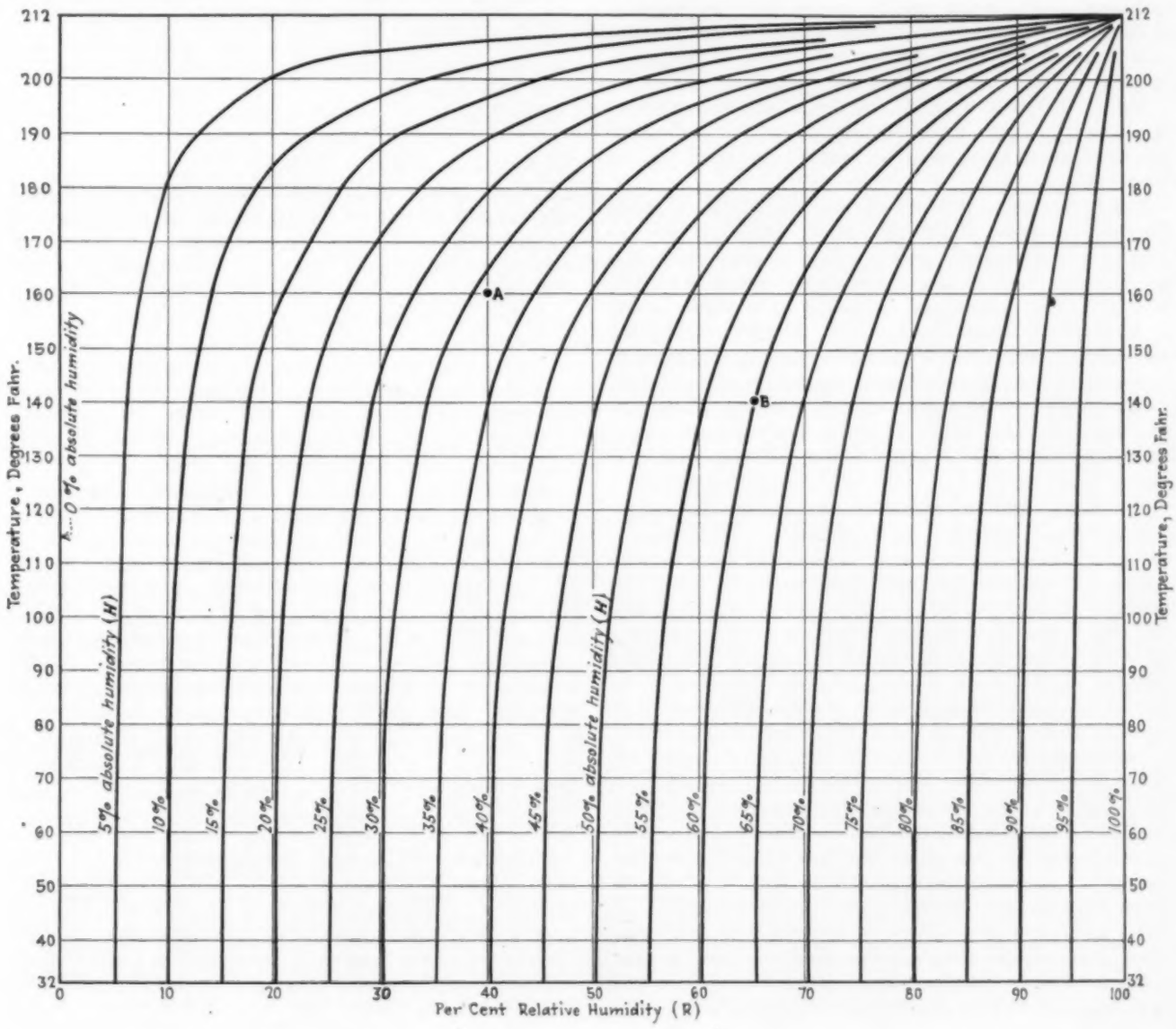
Results of calculations using equations (1) and (2) appear in Tables I and II. For greatest convenience for constant use, perhaps the reader may find it preferable to plot a separate chart for each table. However, for less frequent use, two charts are likely to be somewhat confusing, and on that account only the one employing the data of Table II is reproduced here. It is applicable equally for conversions from relative humidity to absolute humidity or from absolute humidity to relative humidity. This will be apparent from the illustrations given below.

The chart is the result of plotting per cent relative humidity against temperature for curves at intervals of 5 per cent absolute humidity. Thus, any point on the chart has two dimensions of location: temperature and humidity; but the latter may be expressed either as per cent absolute or per cent relative humidity. It is expressed as per cent relative humidity when it is located with respect to the vertical coordinate system; and as per cent absolute humidity when located with respect to the curved coordinate system. Point *A*, for example, is at a temperature of 160 deg., 40 per cent relative humidity and 31.2 per cent absolute humidity. Use of the chart may be illustrated with point *B*. At 140 deg. F., what is the per cent relative humidity corresponding to 60 per cent absolute humidity? *B* is located at the intersection of the horizontal line for 140 deg., and the curve for 60 per cent absolute humidity. Referring to its location in the vertical coordinate system, we find it at 65.2 per cent relative humidity. Conversely, a relative humidity of 65.2 per cent at 140 deg. necessarily represents 60 per cent absolute humidity. In interpolating in the curved coordinate system, it should be noted that interpolation must be carried out on one of the horizontal temperature lines just as it is in the vertical system.

**Conversion Chart for Per Cent Absolute and Per Cent Relative Humidity for Temperatures From 32 to 212 Deg. F.**

**The chart is used for converting either per cent relative humidity to per cent absolute humidity, or per cent absolute humidity to per cent relative humidity. Its use is illustrated by points *A* and *B*. At a temperature of 160 deg. F., what is the per cent absolute humidity corresponding to a relative humidity of 40 per cent? Point *A* demonstrates this. It is located on the horizontal temperature line of 160 deg. at the vertical line, 40 per cent relative humidity. Interpolating on the temperature line between the curves for 30 and 35 per cent absolute humidity, we find an absolute humidity of 31.2 per cent.**

**Point *B* illustrates the reverse process. At a temperature of 140 deg. F., what is the relative humidity corresponding to 60 per cent absolute humidity? Point *B*, located at the intersection of the 140-deg. temperature line and the 60 per cent absolute humidity line, will be seen to represent a relative humidity of 65.2 per cent.**



# READERS' VIEWS AND COMMENTS

*An Open Forum*

*The editors invite discussion of articles and editorials or other topics of interest*

## *Technologic Advances in Chromium Plating*

*To the Editor of Chem. & Met.:*

Sir—The July issue of *Chem. & Met.* contains an article, "How to Improve Durability of Chromium Plate," by R. J. Piersol, which contains several statements with which I do not entirely agree.

He tells us that " . . . operating factors should be so controlled that it is possible to standardize on 15- to 30-minute plates . . . " The great cost for additional equipment needed in every chromium plant to increase the time of deposit to those figures would be prohibitive. Of what benefit would such an increase of time and cost be to the manufacturer or to the ultimate consumer? The time standards now in use allow the production of articles that wear splendidly and have as long a life as is needed. In the automobile industry the standard is that the chromium-plated parts shall retain their good appearance as long as the paint job on the car does.

The author states that, "Even now many platers advise that chromium be plated directly on brass." The example given is that of one who tried to plate chromium on plumbing fixtures, but that probably occurred in 1926 or 1927. The writer has not heard of a plater trying to do that for several years, and diligent inquiry for this purpose has failed to find even one who advises it. In the early days of commercial chromium plating many of us experimented with various under-coatings for chromium deposits, brass included, but we soon found the proper base for it and are today doing what has become standard practice: plating chromium on nickel.

In consideration of variables of plating, the author writes, "These variables are interrelated. In opening a new plant these operating variables should be standardized to their optimum value for the particular article to be plated through the services of a man with comprehensive experience in chromium, rather than left to the haphazard trial and error method of a plater." The plater does not do his work by a "haphazard trial and error method," for the methods used by platers today are as scientific and accurate as the methods used in any industry where chemistry is a factor. The plater knows the chemistry of his work, knows how to analyze his solutions and keep them under perfect control. In short, the plater must know his stuff or he would not long hold his position. The American Electro-Platers' Society has done much research work to elevate the art of plating to the scientific and efficient plane it occupies today.

In the paragraph: "Once these standards are established, the operator should understand that he is subject to dismissal if he purposely attempts to experiment with these constants. This does not limit the ingenuity of the plater, as his inventive activities may be usefully improving the racking of the articles. Such military exactitude is not dogmatic, but it is necessary in order to obtain reproducible results." The author is ambiguous. In one sentence he uses the term "operator" and in another "plater." Naturally, the operator should not in any way interfere with the established practice of a plant, for his duties, as generally understood in shop practice, consist in doing the work assigned to him by the plater. The latter, having charge of the department, is held responsible for production both as to quality and quantity. The human element is the most important factor involved. Even under a full automatic system, an executive is needed to manage the plant, an executive who is capable not only of controlling the solutions but also of controlling the personnel and the production line and who can hold production costs at a minimum. JOS. H. HANSJOSTEN.

C. M. Hall Lamp Co.,
Detroit, Mich.

*To the Editor of Chem. & Met.:*

Sir—In answer to Mr. Hansjosten's comments it need only be said that from the standpoint of the consumer, chromium plate should have a durability of five years rather than the present life. It is unfortunate that any plater should be satisfied with the present durability of chromium, which as yet has not met the specification of the large manufacturer of automobiles.

Commenting on this same article, an engineer who is chief of metal research in a leading refinery questions the statement that chromium fails when plated directly on brass. He says that fairly exhaustive tests in their laboratory fail to substantiate this view. Not only is there a difference of opinion as result of plating chromium on zinc alloys but many manufacturers today are plating chromium directly on brass and nickel silver.

With the advent of chromium plating many of the large companies have been forced to place their plating department under the supervision of a technically trained engineer. The word plater is used as synonymous with operator as opposed to engineer. The purpose of the article is not to discuss the relative merits of a practical operating plater and a technically trained chromium engineer but rather to show the contrasting functions of each. ROBERT J. PIERSOL.

State Geological Survey,
Urbana, Ill.

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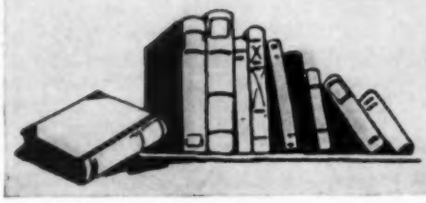
CORRECTION: Through a transposition in captions, the two plants illustrated in the article by Miner L. Hartmann, "California's Diatoms Supply a Wide and Varied Market," appearing in the November issue of *Chem. & Met.*, are incorrectly labeled. The plant on page 652 is that of the Dicalite Co.; the one on page 653, that of the Pacatome Co.

# Chemical Engineer's Bookshelf



## Materials of Construction

WERKSTOFFE: PHYSIKALISCHE EIGENSCHAFTEN UND KORROSION. By *Erich Rabald.* Vol. I, General Data, Metallic Materials; Vol. II, Non-Metallic Materials. Verlag von Otto Spamer, Leipzig, 1931. 976 + 392 pages. Price, 135M.

IN adjudging and reviewing a dictionary, the proper course, as alternative to reviewing each word individually, would no doubt be to approve or deplore the compiler's nicety of selection, to thrill or yawn at his fascination of style, and to compliment or lament the dramatic structure as a whole. The moral being that its usefulness day in and day out would become evident only in the course of daily use.

Manifestly, the work here under consideration presents to its prospective purchaser and reader some of the dictionary's problems. But while its content is just as varied and composite, it differs in being the first and only compendium on its subject. Certainly the engineering world has not been laggard in investigating corrosion, but up to this year no one had published anything so universal and comprehensive. Nor with the emphasis so heavily distributed on physical as well as on actual corrosion properties.

As might be expected, the author approached his task from a wide background of chemical industrial practice. In order to achieve exhaustive coverage of all possible problems, he has arranged his work in three major divisions: general considerations, metals, and non-metals, the latter two being further subdivided according to materials, and all of them supplied with thorough indexes. In order to achieve completeness of data, he has drawn heavily on such contemporary work as that of Evans, Pollitt, Fürth, the Bureau of Standards, several Americans and, of course, numerous Germans. Because compilation and selection had to play such a great part, the volumes are strongly documented throughout.

Again faced with the dictionary-like aspects of the work, one can best judge its type of presentation through an example: *Division,* Metals; *Section,* Copper; Trade Forms: wire, sheet, etc., specification and weight tables, crystalline structure, etc.; Corrosion Resistance: general, specific reagents, data and tables; Copper Coatings; Copper Alloys: brasses and bronzes (numerous data on shapes, sizes, and corrosion); Copper-Nickel Alloys, physical constants, corrosion resistance, tables; Other Copper Alloys; references, 29 pages; total, 120 pages.

In this exhaustive fashion the author deals with all possible materials of construction, a treatment which was particularly needed in the non-metallics section. Whether the book is soon translated or not, it goes without saying that it demands consultation wherever corrosion is a factor or wherever chemical apparatus is to be selected.

## Applying Chemical Mathematics

INDUSTRIAL CHEMICAL CALCULATIONS. By *O. A. Hougen* and *K. M. Watson.* John Wiley & Sons, Inc., New York City, 1931. 502 pages. Price, $4.50.

*Reviewed by* BARNETT F. DODGE

MUCH of the space in the best known texts on the unit operations of chemical engineering is given over to a discussion of the underlying physical and physico-chemical principles. Although most students will have had elementary courses in physics and physical chemistry before taking up the study of the unit operations, the ground to be covered in these courses is so great that the treatment of any one subject must, of necessity, be rather superficial. Hence, teachers of chemical engineering have found it necessary first to review and then to treat in greater detail the most important underlying principles before proceeding with the engineering applications. In this book the authors have attempted to bridge the gap between the usual courses in physics and physical chemistry and the study of chemical technology and the unit operations. In the reviewer's opinion, they have succeeded admirably.

The subject matter of the book is essentially applied physical chemistry. There has been no attempt to discuss the unit operations or industrial chemical processes as such, though some of them are introduced in a more or less incidental way in the problems. Nor does the book attempt to cover the field of physical chemistry, since many of the most important subjects, from a purely scientific point of view, are omitted. The authors have selected a number of physical and physico-chemical principles that are important from an industrial viewpoint and have given them a more intensive treatment than is found in the usual elementary texts. The pressure-volume-temperature relationships of pure gases and mixtures of gases, elementary thermodynamics, vaporization and condensation phenomena, thermochemical calculations, chemical equilibria, distillation equilibria, and weight and heat balances of combustion processes and of various chemical and metallurgical processes are among the subjects treated.

Each subject is developed from first principles and then illustrated by the solution of numerical problems, the data for which were taken, for the most part, from industrial practice. In addition to the numerical illustrations, of which there are 113 in all, and some of them quite long, there is added at the end of each chapter a set of problems to be worked. The illustrations and problems, totaling 359, are the outstanding feature of the book. It should be of value to the teacher of physical chemistry, the teacher of chemical engineering, and the chemist or engineer in industry who wishes to review the application of physico-chemical principles to industrial problems.

## Modern Evaporation Practice

VERDAMPFEN, KONDENSIEREN UND KÜHLEN. By *E. Hausbrand,* Seventh Edition, completely rewritten by *M. Hirsch.* Verlag von Julius Springer, Berlin, 1931. 359 pages. Price, 29 M.

*Reviewed by* ALBERT B. NEWMAN

THIS SEVENTH EDITION of the outstanding German work on evaporation, condensation, and cooling is really a book on the theory and practice of evaporation. In the preface, Hirsch explains that comprehensive works on condensation and on refrigeration have been recently published and that it seemed best to restrict the Hausbrand-Hirsch revision to the subject of evaporation, retaining the old title as a mark of respect to Hausbrand. Because of the amount of fundamental research which has been done since the appearance of the previous editions, it was decided that the book would have to be completely rewritten, this edition marking the transition from the older empirical methods to the newer methods based on scientific investigation.

The book is elaborately organized into parts, divisions, subdivisions, etc., each lettered or numbered in the table

of contents and in the text. There are two main parts: Fundamental Principles and Calculations, and Detail Design and Applications.

The main sections of the first part are: fundamental concepts and laws, fluid flow and heat transfer, multiple-effect evaporation, preheating, the evaporator as a heat transformer, batch evaporation, evaporation with vapor compression, flash evaporation. The treatment is along modern chemical engineering lines, taking advantage of physico-chemical principles where possible.

A useful type of chart is the so-called $J$-$x$ diagram on which $J$ is the total heat content above 0 deg. C. of a solution containing unit weight of dissolved substance and $x$ is the solution strength expressed in weight of solvent per unit weight of dissolved substance. In evaporation processes, the one unchanging value is the weight of dissolved substance, and the usefulness of such a chart can be readily visualized. The numerical values are represented by a series of isotherms, each isotherm being related to an isobar lying above it. For any given strength $x$, the height of the isotherm is the heat required to raise that strength of solution to that temperature; for the same $x$, the height of the isobar is the heat required to raise the solution to a temperature at which it has the same vapor pressure as the pure solvent would have at the temperature of the isotherm. Thus the thermal relations between evaporation and condensation of vapor can be read directly from the chart.

Evaporation is represented by a sloping line from one strength to another, the slope being the heat of vaporization. Solubility curves also are shown on the same chart. Inasmuch as the treatment of all of the different evaporating schemes is based on this chart, an understanding of its essential features is necessary in studying the text. The charts are purely diagrammatic and one wishes that the author had included a chart or two for actual dissolved substances, built up from accurate specific heat data and other thermodynamic quantities. The reviewer predicts a wide adoption of the $J$-$x$ diagram in studying possibilities and solving problems in multiple-effect evaporation.

Most of the important research investigations have been included in the book, with literature references, and the breadth of viewpoint is indicated by the very considerable space given to the results of American research workers, particularly to those of Badger and his students.

The second part of the book describes the various commercial types of evaporators, with details and accessories, and again one notes the blending of European and American design. There also is a thorough discussion of the specific application of the various types to particular industries and products.

The system of symbols used throughout the book differs from the ones familiar to American engineers and the terminology in many cases would be found difficult to translate by a reader with only a casual knowledge of German. Such a thorough and excellent treatise on evaporation should be available in English, and a translation which presented a more familiar nomenclature would be welcomed by the many engineers and students interested in evaporation.

## Electrochemical Engineering

INDUSTRIAL ELECTROCHEMISTRY. By *C. L. Mantell.* McGraw-Hill Book Co., New York City, 1931. 528 pages. Price, $5.

*Reviewed by* S. SKOWRONSKI

IN THE preface the author states that "The title 'Industrial Electrochemistry' is intended to be broadly inclusive of the theoretical and technical sides of electrochemistry, the aqueous and fused electrolyte industries, electrothermics, and the electrochemistry of gases, as well as the distinct engineering aspects."

Accordingly the book has been divided into six parts. Part I takes up the scope of electrochemical industries and the fundamental theories of electrochemistry. Part II deals with technical electrochemistry, which the author divides into electrolytic reduction and oxidation, corrosion, primary and secondary cells and rectifiers. The electrodeposition, recovery, and refining of metals both in aqueous solutions and in fused salts is described in Part III, which the author titles "Electrolytics" and which covers 40 per cent of the book. Part IV deals with the various types of electric furnaces and the manufacture of electrothermal products. Part V relates to the electrochemistry of gases, including nitrogen fixation and electronics. In Part VI the author discusses the materials of construction, such as various types of anodes, tank materials, furnace electrodes, refractories and conductors. This part also includes an instructive chapter on power generation and the economics of the electrochemical industry.

The book is well written and covers the electrochemical industry quite thoroughly in a comparatively small volume. In order to do this the author has had to limit himself to modern practice and the book is unusually free from description of historical and antiquated or obsolete processes.

The author has collected a large quantity of data giving details of various plant operations and construction which appear in 51 tables. The book is well illustrated, photographs and curves numbering 178. The number of references to the existing literature is surprisingly small, considering the scope of the book.

The book is a valuable contribution to the literature of electrochemical and chemical engineering; it will be welcomed by teachers as a textbook of modern theories and processes. It is recommended to technical and practical men for the large quantity of practical data which it contains, the original manner in which the various subjects are presented, and for the presentation of the economics of the electrochemical industry.

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CROMATURA ELETTROLITICA. By *Oswaldo Macchia.* Ulrico Hoepli, Milano, Italy, 1931. 489 pages.

*Reviewed by* COLIN G. FINK

THIS extensive work on chromium plating is a carefully prepared compendium on almost everything that has been published on the subject within recent years. Liberal use is made of curves and illustrations from many of the publications that have appeared in this country. Considerable space is devoted to the historical development of the subject. Among the chapter headings may be mentioned: "Analytical Control of Chromium Plating Solutions," "Theory of Electrodeposition," "Anodes," "Laboratory and Factory Technique," "Precautionary Measures," and "Cost of Chromium Plating."

The main purpose of this book undoubtedly is the acquaintance of the Italian industries with the rapid development of the art which has taken place in America, Germany, England, and France. It is indeed gratifying to the reviewer to look upon this project as a reflection of the rapidly expanding electrochemical industry in Italy.

## Plastic Products

HANDBUCH DER KÜNSTLICHEN PLASTISCHEN MASSEN. By *Oskar Kausch.* J. F. Lehmanns Verlag, München, 1931. 353 pages. Price, 22 M.

*Reviewed by* A. F. RANDOLPH

THE editor of *Kunststoffe,* Dr. Kausch, celebrates the twenty-first birthday of this leading periodical in the plastics field by giving us a book which is a welcome and valuable addition to the rather limited group of recent works on the subject.

It is primarily a systematic review of the patents of the whole field of plastics, omitting artificial silk, coated fabrics, artificial stone, and rubber. Divided into chapters in accordance with a rational classification of plastics into fourteen types and numerous sub-types, the book gives brief but adequate abstracts of some two thousand patents, together with some general information as to the charcteristics and usefulness of each type.

Space is devoted most generously to plastics of albuminous base, including casein, (59 pages), to those of cellulose derivatives (75 pages), and to condensation products (34 pages). But the other groups are not slighted; in the group of bituminous base, for example, some 130 patents are cited. Naturally, German patents have been the most thoroughly covered, but over 500 United States patents are represented.

Of course, a book which covers so wide a field cannot displace the more exhaustive works of narrower scope, such as Worden, Ellis, Hemming, Scheiber and Sändig, but it covers, I believe, certain ground not covered by any of these, and including, as it does, patents up into 1930, comes more nearly up to date than any but the last-named. The book is comprehensively indexed by name and by subject and has a numerical index of patents and a bibliography. There also is a trade-name list giving the classification and the manufacturers' names for some three hundred plastics.

ARTIFICIAL RESINS. By *Johannes Scheiber* and *Kurt Sändig*. Translated by *Ernest Fyleman*. Isaac Pitman & Sons, Ltd., 2 West 45th St., New York City, 1931. 447 pages. Price, $9.

BECAUSE the original German edition of this useful work was exhaustively discussed in a review by Carleton Ellis at the time of its appearance (see *Chem. & Met.*, Vol. 36, 1929, p. 688), it is unnecessary to go additionally into this English version. The translator has performed competently his sole aim, to "reproduce, as accurately as possible, the meaning of the authors." It may also be noted that the publishers have advanced the price over the already costly German edition.

## Chemical Microscopy

HANDBOOK OF CHEMICAL MICROSCOPY, II. By *Emile Monnin Chamot* and *Clyde Walter Mason*. John Wiley & Sons, Inc., New York City, 1931. 411 pages. Price, $4.50.

*Reviewed by* JOHANNES KAULKE

IN THIS second volume, microscopical qualitative analysis is discussed in detail. The micro-analytical methods employed are simple and rapid rather than highly sensitive; however, these factors give chemical microscopy the preference over other methods. Therefore we find in the first two chapters of the volume a detailed description of the technique required to prepare samples for microscopical examination. Characteristic relations of the elements are then given together with many accompanying photomicrographs. Since the elements are treated in groups according to the periodic table, these photomicrographs are of vast importance. They clearly illustrate the different crystalline forms obtained when a reagent common to this group reacts with its different members.

The anions and cations are then treated in systematic groups and organic acids also are considered. A chapter is then devoted to the effect of special reagents on numerous cations as well as a chapter on how some of these special reagents may be readily prepared. Finally, an outline is given for the micro-analysis of a substance of an unknown composition together with the scheme for the rapid analysis for the common non-ferrous and ferrous alloys.

In conclusion, it may be said that this volume on chemical microscopy should become an indispensable source of knowledge for the micro-analyst in industrial and research work.

## Recent Arrivals

A COMPREHENSIVE TREATISE OF INORGANIC AND THEORETICAL CHEMISTRY. Vol. XI, Tellurium, Chromium, Molybdenum, Tungsten. By *J. W. Mellor*. Longmans, Green & Co., New York City, 1931. 909 pages. Price, $20.

EVERY appearance of a new volume from Mellor now becomes an increasing signal of achievement. The nature of the work, as a source of a reference, renders futile all efforts to evaluate the detail in the present volume; this will become evident only after long and constant service. As in his past endeavors, however, Dr. Mellor has assembled a stupendous mass of scientific reference in the treatment of these four elements, and if its predecessors may serve as indicators, this one will be equally useful. Only two volumes now remain to fill this complete chemical reference shelf.

TECHNICAL METHODS OF CHEMICAL ANALYSIS, III. By *G. Lunge* and *C. A. Keane*. Second Edition, Edited by *C. A. Keane* and *T. C. L. Thorne*. D. Van Nostrand Co., Inc., New York City, 1931. 678 pages. Price, $18.

IN the same year as the appearance of a new revised Lunge-Berl, English-speaking technologists are having their own handbook of analysis brought a step nearer to date by the appearance of this third volume, leaving three more to complete the series. In the present volume, the subjects treated are: Clays, ceramics, and refractories; glass; calcareous cement; water supplies and sewage; fertilizer; soils; air; and fodder. The authors are British authorities, but American sources are widely used.

THE SWEDEN YEAR BOOK, 1931. American-Swedish News Exchange, Inc. New York City, 1931. 317 pages. —Very interesting and well-prepared book on all phases of Sweden's place in the world, including her industries, commercial relations, and natural resources.

THE MINERAL INDUSTRY, Its Statistics, Technology and Trade During 1930. Vol. XXXIX. Edited by *G. A. Roush*. McGraw-Hill Book Co., Inc., 1931. 815 pages. Price $12. The annual task of revision this time includes a few slight changes of authorship and arrangement.

GEMS AND GEM MATERIALS, By *Edward Henry Kraus* and *Edward Fuller Holden*. University of Michigan. McGraw-Hill Book Co., Inc., New York City. 260 pages. Price $3.50. — The second edition of this well-known text has appeared and, in spite of the fact that one does not put much serious thought on gems and gem materials during these days, the reader will find this text to be a very interesting story, well worth the time necessary for its perusal.

WESEN, URSACHEN UND VERHÜTUNG DER KOHLENSTAUBEXPLOSIONEN UND KOHLENSTAUBBRÄNDE. By *H. Steinbrecher*. Wilhelm Knapp, Halle, Germany. 77 pages. Price, 8.20 M.— As a further addition to the series "Kohle-Koks-Teer" this volume covers (1) nature of coal-dust explosions and coal-dust fires; (2) physical and chemical influence of factors contributing to coal-dust explosions and fires; (3) causes and prevention of coal-dust explosions and fires; (4) general and special rules concerning coal dust.

GENERAL CHEMISTRY, THEORETICAL AND DESCRIPTIVE. Second Edition. By *Thomas P. McCutcheon, Harry Feltz* and *G. C. Warner*. D. Van Nostrand & Co., Inc., New York City, 1931. 533 pages. Price, $3.50—In this revision several chapters have been enlarged to deal with new evidence; the text as a whole has been rather thoroughly overhauled on the basis of experience and use.

A SHORTER COURSE IN ORGANIC CHEMISTRY. By *J. C. Colbert*. The Century Co., New York City, 1931. 352 pages. Price, $3.60.—A fresh viewpoint applied to a condensed study of organic chemistry, stressing problems and exercises.

## Society Publications

INSTITUTION OF CHEMICAL ENGINEERS, Transactions. Vol. 8, 1930. Published by the Institution, London, 1931. 232 pages.—This year's collection of papers bears mainly on chemical waste disposal, although other topics are included.

CHEMICAL ENGINEERING GROUP, SOCIETY OF CHEMICAL INDUSTRY, Proceedings. Vol. XI and XII, 1929 and 1930. Published by Chemical Engineering Group, London, 1931. 153 pages.

A. S. T. M. TENTATIVE STANDARDS, 1931. American Society for Testing Materials, Philadelphia, Pa., 1931. 1,008 pages.

PETROLEUM PRODUCTS AND LUBRICANTS, and Methods of Tests. Report of Committee D2, American Society for Testing Materials. Philadelphia, Pa., 1931. 267 pages. Price $1.25.

PAPERS of the 25th general meeting of the deutschen Bunsen-Gesellschaft with symposium on light metals. Verlag Chemie, G. m. b. H., Berlin, 1931. 353 pages. Price, 16 M.—Besides the principal topic of this volume, the progress of metallurgy and its application to the light metals, which takes up 68 pages, there are the following: the physics and the chemistry of metals; technical metallurgy; recrystallization; crystal structure; spectra and molecular structure; general physical chemistry; surface chemistry, kinetics, photo effect; electrolytes; and electrochemistry.

# SELECTIONS FROM RECENT LITERATURE

CONCENTRATION CONTROL. O. Teufert. *Chemische Fabrik*, Nov. 18; pp. 445-6. There are numerous chemical and processing operations in which there would be great advantage in being able to feed fresh or hot water automatically into a concentrated solution in correct proportion for maintaining correctly a predetermined concentration. The usual expedient, a hand-operated valve for adding fresh water, lacks precision as well as convenience. It also involves the human element; the operator may or may not be both attentive and skillful. An automatic control device, to be both sensitive and accurate, must be as free as possible from friction and inertia in its operation, and the means adopted to prevent excessive control activity must not have such a strong damping effect as to cause any lag in the functioning of the device. In a new automatic concentration controller, developed to meet these requirements, liquid is withdrawn from the main body of liquid to be controlled into a small container in which there is a float, adjusted to a specified range of specific gravity of the liquid. This float is arranged so that, on passing either the upper or lower limit, it actuates a small nozzle, fed with compressed air or compressed oil as the source of energy for turning the fresh water valve off or on, as required. The nozzle is movable; the action of the float is merely to move it into or out of its operative position. A suitably adjusted spring prevents excessive action of the controller. The operating cost is small, requiring only a small motor to drive the air (or oil) compressor.

MIXED VAPOR ENGINES. F. Bosnjakovic. *Zeitschrift des Vereines Deutscher Ingenieure*, Sept. 19; pp. 1197-1201. In view of the growing interest in mixed vapor systems for power generation, a study has been made of the thermodynamic properties of benzene and water, as a suitable pair representing the immiscible type of pairs of liquids. It is shown that a graphic solution of all the important problems of such a system is possible by means of a heat content—composition—entropy diagram. Careful analysis of the respective thermal efficiencies reveals a slightly better figure for steam than for mixed vapor systems. Steam, in a Carnot cycle operating between 150 and 69 deg. C., has a thermal efficiency of 0.192; without superheating, the cycle in an ordinary steam engine has a thermal efficiency of 0.182; a numerical calculation for the benzene-water mixed vapor system indicates the thermal efficiency to be 0.176, which is not in agreement with certain experimental results in which a mixed vapor engine showed an apparent advantage over steam in thermal efficiency. The discrepancy, however, is due to differences in experimental conditions which invalidate the comparison and not to faulty calculations of the thermal efficiencies. The reason for the relatively lower efficiency of the mixed vapor engine is that the final expansion temperature cannot reach the lowest condensate temperature as can be done with steam.

DRYERS FOR CHEMICAL PRODUCTS. Link. *Chemiker-Zeitung*, Oct. 7; pp. 772-4. Recent developments for dryers are described and illustrated, with particular reference to drying of chemical products. The new designs utilize a vertical turbine type of construction and operate on a very low power consumption rate, on account of their economical system of air supply. The turbine runs merely on two ball bearings; the drying trays, arranged in two series, make only a few revolutions per hour and so require only a little power. Space requirements are small, because each series of drying trays is arranged vertically instead of horizontally. The new dryers are particularly suitable for drying pasty, sticky, or viscous materials; but they may also be used to excellent advantage for powdered or crystalline products. The conditions of mild yet effective drying are provided by spreading the material in thin layers to present a large evaporation area, turning it at intervals as it changes from one tray to the next, and exposing it to alternating flow of uniformly rapid air currents. By using the countercurrent principle, damage to the goods by excessive superficial drying is avoided. Accurate temperature measurement and control are facilitated by use of graduated, regulatable heating surfaces; and heat economy is favored by circulating the air through the dryer in such a way that it reaches its greatest degree of saturation. As drying proceeds, the temperature decreases from zone to zone so that the material at the discharge outlet is at atmospheric temperature. If required, the dryers may be equipped with refrigeration units so that the material is delivered cold. The construction of the new dryers is illustrated by drawings and photographs.

VACUUM TUBES. Werner Hitler. *Chemische Fabrik*, Sept. 30, pp. 389-92, and Oct. 7, pp. 398-400. The modern development of the vacuum tube has opened up many possibilities for simple but highly sensitive instruments for measurement and control of properties and operations in the process industries. Some of the principal applications are in measurements of electrical properties; for example, dielectric strength is measured by comparing capacity changes in an air condenser with those in a condenser containing the dielectric to be tested. This is done by a suspension method (long wave lengths) or by a resonance method (very short wave lengths). Electrical conductivities are measured by a tone frequency method. In certain other physico-chemical measurements vacuum tubes are used as rectifiers for alternating current, or as amplifiers (at low frequencies). There is also a considerable field for the vacuum tube in potentiometric titrations, for which a method has been devised which is independent of the internal resistance of the element being measured. This method suffers, however, from fluctuations in the setting of the instrument, due to inconstancy of the heating current. The vacuum tube can also be used to good effect in measurement and control of non-electric properties of systems; for example, temperature and pressure. An illustrated description is given of a set-up for use as a thermo-regulator in the operation of thermostats; and the principle involved in remote-reading indicators for small pressures is discussed. On account of the many possible variations in use and the different electrical set-ups to which the vacuum tube is adaptable, it is to be expected that numerous other applications in physico-chemical measurements and in process control will be found and utilized.

ACIDPROOFING IRON. F. Kolke. *Farben-Zeitung*, Sept. 26; pp. 2235-8. In view of the comparative inadequacy of the usual acidproof coatings for protecting iron surfaces from acid attack, a study has been made of the possibility of improving the efficacy of such coatings by a preliminary phosphatizing treatment (Parker process, Bonderite process, Atrament process). Six different acidproof lacquers were applied to test panels, phosphatized and plain, and the panels were exposed to 3 per cent solutions of acetic, sulphuric, phosphoric, and hydrochloric acids. Three of the six lacquers had phenolic resins as film-forming material; one contained shellac, one was bituminous and one contained a cellulose ester. The observations are tabulated, and photographs of test panels are shown, as taken after the tests. With the inorganic acids, there was a decrease rather than an increase in the acid resistance of the phosphatized panels, as compared with the untreated panels. This negative benefit of phosphatizing is considered to be influenced mainly by the permeability of the coating films and by the solubility relations of the phosphate salts in the test solutions. The general conclusion is that the corrosion-resisting effect imparted by phosphatizing, even with the added protection of

lacquers, with respect to acid resistance is not at all comparable with the protection afforded with respect to weathering or immersion in fresh water or sea water.

RECTIFICATION. E. Kirschbaum. *Zeitschrift des Vereins Deutscher Ingenieure*, Sept. 26; pp. 1212-6. Efforts to lessen the necessary height of fractionating columns have been mainly along the lines of structural modifications. Various designs of capped bell trays have given noteworthy improvements. Plate trays have been found to be unsuitable, but the use of tower filler masses has advantages with respect to tower height. Therefore attention has been given to improving the efficacy of filled towers with respect to length of trickling path, heat transfer relations between liquid and vapor, and the distribution of liquid within the tower. This last factor is one which presents particular difficulties. It is shown that optimum distribution requires that the liquid shall be passed from the periphery of the column toward its center, with provision for preventing "dead corners" (unutilized areas of surface), so that uniform distribution of liquid over the cross-sectional area of the tower is attained. It has been found that the best tower shape for this purpose is an inverted cone with the vapor inlets arranged to prevent passage of liquid inlets through any but the liquid inlets. The vapor inlets should have a larger total area than the liquid inlets and the number of liquid inlets should increase toward the middle of the tower. Drawings, curve charts, and photographs are shown. The recommended design has advantages for use in other operations where liquid distribution is an important factor; for example, in absorption towers and the like.

SOLVENT RECOVERY. Ernst Schlenker. *Gummi-Zeitung*, Aug. 21; pp. 1859-60. In the recovery of volatile solvents from effluent air of any solvent-using process, the Bregeat absorption method shares with adsorption the advantage of being effective at low concentrations of the solvent vapor. This permits working at concentrations below the explosive limits for flammable solvents. The merits of the more modern refrigeration method are still a matter of discussion. The principal merit of the Bregeat process lies in the high absorption capacity of the cresols for oxygenated solvents (alcohols, ethers, esters, etc.), with which loose molecular compounds are formed. The applicability of this method is limited, because no such compounds are formed by the cresols with some of the volatile solvents in common use.

# Recent Government Publications

*Documents are available at prices indicated from Superintendent of Documents, Government Printing Office, Washington, D. C. Send cash or money order; stamps and personal checks not accepted. When no price is indicated, pamphlet is free and should be ordered from bureau responsible for its issue.*

*French Chemical Industry and Trade in 1930*, by Earle C. Taylor. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 781; 10 cents.

*Chemical Industries and Trade of Norway and Denmark*, by William T. Daugherty. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 780; 10 cents.

*Industrial Machinery Market of Yugoslavia*, by Emil A. Kekich. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 777; 10 cents.

*International Trade in Fish Meal*, by George J. Carr. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 779; 10 cents.

*Market for Paper and Paper Products in Cuba*, by William B. Murray. Bureau of Foreign and Domestic Commerce Trade Information Bulletin 782; 10 cents.

*Organization of German Plastics and Molded Products Industry*, by Sydney B. Redecker. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 356; mimeographed.

*Sodium Phosphate Developments—Canada*, by Aylwin Probert. Bureau of Foreign and Domestic Commerce Chemical Division Special Circular 357; mimeographed.

*Commercial Travelers' Guide to Latin America*, Fourth Edition, 1931. Bureau of Foreign and Domestic Commerce Trade Promotion Series 122; $1.50. A commercial geography of Latin America.

*Fuel and Power in Latin America*, by J. R. Bradley. Bureau of Foreign and Domestic Commerce Trade Promotion Series 126; 25 cents.

*Mineral Resources of the United States, 1930 (Summary)*. Bureau of Mines pamphlet, 20 cents.

*Coal in 1929*, by F. G. Tryon and L. Mann. Bureau of Mines Mineral Resources pamphlet, 35 cents.

*Publications of the Bureau of Foreign and Domestic Commerce*, October, 1931, edition. Issued by the Bureau of Foreign and Domestic Commerce.

*Influence of Fractionation on Distribution of Sulphur in Gasoline*, by Ralph H. Espach and H. P. Rue. Bureau of Mines Technical Paper 505; 10 cents.

*Twenty-Third Semi-annual Motor-Gasoline Survey—Part III*, by A. J. Kraemer, E. L. Garton, and E. C. Lane. Bureau of Mines Report of Investigations 3152; mimeographed.

*Jigging, Classification, Tabling and Flotation Tests of Coals With Particular Reference to Coals From Pierce County, Washington*, by B. M. Bird, and S. M. Marshall. Bureau of Mines Bulletin 337; 35 cents.

*Methods and Costs of Concentrating Tungsten Ores at Atolia, San Bernardino County, Calif.*, by W. O. Vanderburg. Bureau of Mines Information Circular 6532; mimeographed.

*Iron in Pigs and Iron Kentledge*. U. S. Tariff Commission Report No. 23, Second Series; 10 cents. Report to the President on differences in costs of production in the United States and the principal competing country.

*Foreign Commerce and Navigation of the United States, Calendar Year 1930*. Bureau of Foreign and Domestic Commerce. Bound volume, $2. Gives import and export statistics.

*Relative Growth of Coal, Oil, and Water Power*. Bureau of Mines mimeographed statement, from Weekly Coal Report No. 746.

*Mineral Production Statistics for 1930*. Separate pamphlets from Bureau of Mines on: Sulphur and Pyrites, by Robert H. Ridgway, 5 cents; Mercury, by Paul M. Tyler, 5 cents; Silica, by E. R. Phillips, 5 cents; Platinum and Allied Metals, by Hubert W. Davis, 5 cents; Arsenic, Bismuth, Selenium, and Tellurium, by V. C. Heikes, 5 cents; Lead and Zinc Pigments and Salts, by Elmer W. Pehrson, 5 cents; Feldspar, by H. H. Hughes and Jefferson Middleton, 5 cents; and Abrasive Materials, by Paul Hatmaker and A. E. Davis, 5 cents.

*Mineral Production Statistics for 1930*—preliminary mimeographed statements from the Bureau of Mines on: sand and gravel and natural gasoline.

*Federal Specifications*. Issued by Federal Standard Stock Catalog Board as follows: Chrome yellow, dry and paste in japan, paste in oil (lemon, medium, orange); lithopone paints, interior (flat and egg-shell finish); volatile mineral spirits paint thinner; basic sulphate white lead, dry and paste-in-oil; gum-spirits of turpentine and steam-distilled wood turpentine; petroleum asphalt; leaded zinc oxide; asphalt for use in road pavement and construction; motor gasoline:

## Miscellaneous Publications

*Normblätter für Säurefestes Steinzeug*, Dechema, Seelze (Hanover), Germany—This "Standards for Acidproof Stoneware" is a series of specifications and drawings embodying accepted standards promulgated for use in the chemical industry.

*Studies in Heat Transmission*, particularly as applied to tubular gas condensers. By Allan T. Colburn and Olaf A. Hougen. Engineering Experiment Station Series No. 70, University of Wisconsin, Madison—A 158-page booklet of computations and studies of a fundamental chemical engineering nature.

*Structural Steel Welding Committee* of the American Bureau of Welding, Report. American Welding Society, New York, 1931. 208 pages. Price, $1—Consisting mainly of tables and charts, this report aims to determine the safe design values in welding and a degree of uniformity to be expected in normal fabrication.

*Nova Scotia, Canada, Resources and Developments*. By H. F. Philpot. Department of Interior, Ottawa, Canada. 157 pages—A revised illustrated edition on the natural resources, industries, and industrial prospects of this province.

*The Practice of Spectrum Analysis*. Fifth edition.—*Wave Length Tables for Spectrum Analysis*. By F. Twyman and D. M. Smith.—*Foundations of Chemical Analysis by the Emission Spectrum*. By Walther Gerlach and Eugene Schweitzer.—Three recent publications of the firm of Adam Hilger, Ltd., London, which serve a useful scientific purpose in addition to publicizing the services of that company. In particular, the last volume mentioned represents, by its translation from German, an especially useful contribution to available studies on the subject in English.

*Richtlinien für die Vergebung und Abnahme von Koksofen*. Verlag *Glückauf*, G.m.b.H., Essen, Germany. 34 pages.—"Directions for the Estimation and Supply of Coke Ovens" is published by several technical German societies to remove the uncertainty in the purchase of coke ovens by standard consideration.

*Fighting Fires Which Involve Chemicals*. By L. K. Arnold and L. J. Murphy. Bulletin 109, Engineering Extension Service, Iowa State College, Ames, 31 pages—Instructions to those responsible for safety maintenance and upkeep in the rudiments of hazards involving chemicals.

*Industrial Alcohol and Other Non-Beverage Liquors*, Permit procedure relating to. U. S. Treasury Department, Bureau of Industrial Alcohol, Washington, D. C. 43 pages—Convenient outline of the hocus-pocus necessary for obtaining "legal" alcohol.

*Convention Dates of Trade Associations*. U. S. Chamber of Commerce mimeographed document issued October, 1931—Includes national, international, interstate, and state trade associations, giving time and place of meetings, listed geographically according to cities in which the meetings are scheduled to be held.

*The Sulphur Compounds in Water-Gas and Their Removal*. By W. E. Bakes, J. G. King, and F. S. Sinnatt. British Library of Information, 551 Fifth Ave., New York City. 35 pages. Price, 20 cents—An experimental study on the nature of the sulphur compounds in water gas and their removal by charcoal, using a method of reactivation involving steam-air-ammonia mixtures and other triple gas mixtures. The experiments indicated satisfactory removal by charcoal, particularly of organic sulphur compounds, the cost of purification under British conditions amounting to 0.32d. per 1,000 cu.ft.

# THE PLANT NOTEBOOK

## Improved Apparatus for Thermal Conductivity

By H. Stiles
*Department of Physics*
*Iowa State College, Ames, Iowa*

IN THE October, 1929, issue of *Chem. & Met.* (page 625), the writer described an apparatus for measuring the thermal conductivity of certain heat-insulating materials. For the boiler used in that apparatus, a substitute has been designed, as is shown in the drawing. The measuring part of the apparatus, which expresses heat transfer in terms of the shrinkage of an ice-water mixture, has been retained, and is shown on top of the new boiler. With the former apparatus, the opposite faces of the test specimen were kept at the temperatures of steam and melting ice, respectively; whereas, with the modified apparatus it is possible to vary the higher temperature over quite a range by regulating the temperature of the water in the tank.

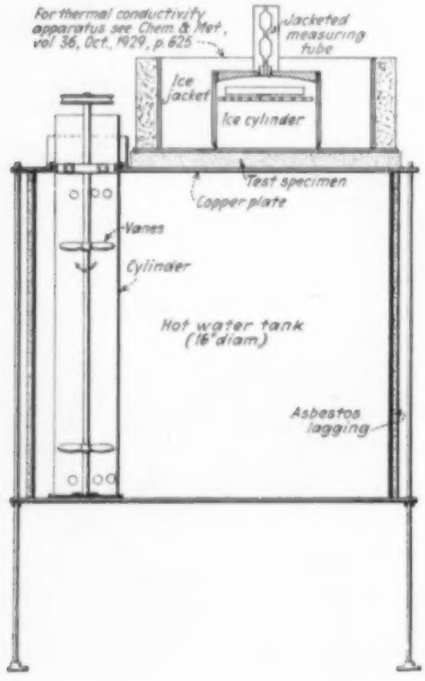
For an explanation of the use of the apparatus, the reader should refer to the earlier article. However, briefly, the method is to clamp the specimen between the ice vessel and the hot water tank, being sure that the upper temperature is constant at 32 deg. F. Passage of the heat through the specimen is then determined by timing the water-level drop in the measuring tube, which depends on the rate of melting of the ice in the cylinder.

The tank is a copper cylinder, 14½ in. high and 16 in. in diameter, holding approximately 100 lb. of water. The water may be heated by a bunsen burner below and by a thermostatically controlled 250-watt heating element within, not shown in the figure. Because of the large heat capacity of the water, it has been found possible, after a little practice, to keep the temperature of the water constant to within one-half degree for hours by means of the gas flame alone. The stirring device shown in the figure consists of two sets of vanes mounted on a shaft placed in a brass cylinder 3 in. in diameter. The pulley at the top of the shaft is belted to a ¼-hp. motor and the water circulated through the holes.

Experiments are carried on in the manner described in the former paper. Some results obtained with a certain specimen of wallboard made from cornstalks are as follows:

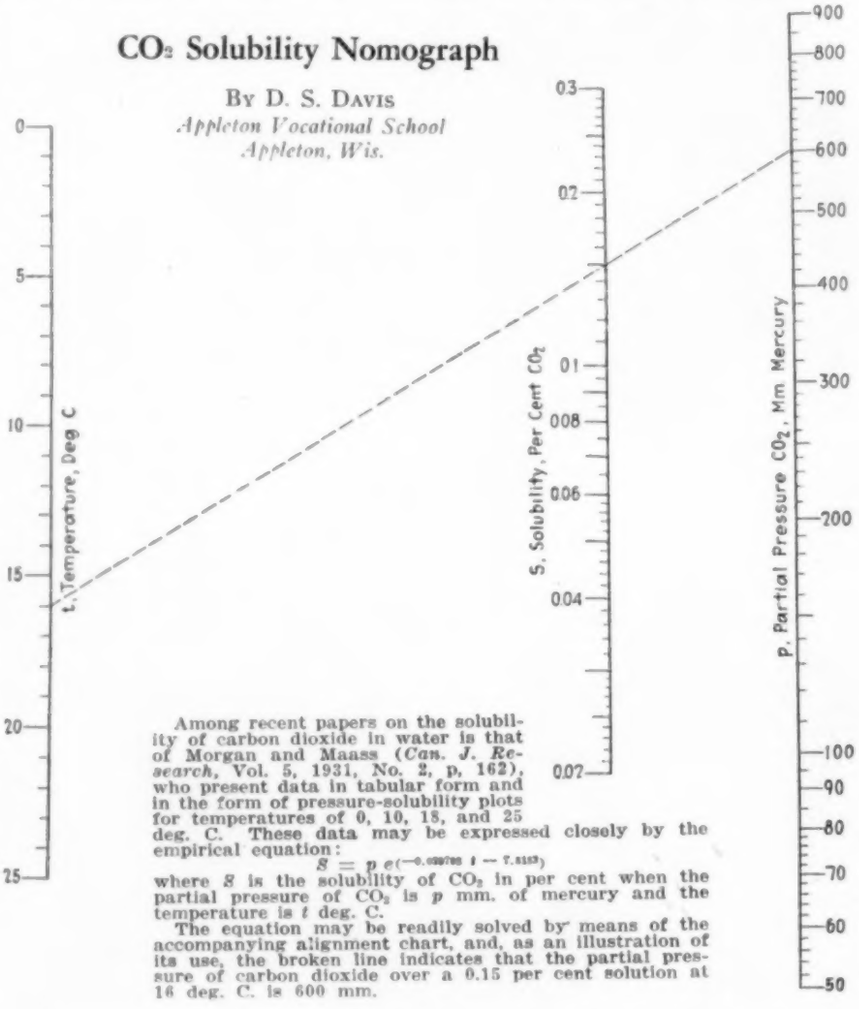
| *T* | *K* | *T* | *K* |
|---|---|---|---|
| 110 | 0.376 | 76 | 0.348 |
| 98 | 0.368 | 69 | 0.345 |

The sample was dried in an oven at 70 deg. C. for four hours before using. *T* in the table refers to the mean temperature of the specimen to the nearest degree F. *K* is the specific thermal conductivity expressed in B.t.u. per hour per square foot for a temperature gradient of 1 deg. F. per inch of thickness. Other specimens also showed a comparable conductivity variation.




## $CO_2$ Solubility Nomograph

By D. S. Davis
*Appleton Vocational School*
*Appleton, Wis.*




Among recent papers on the solubility of carbon dioxide in water is that of Morgan and Maass (*Can. J. Research*, Vol. 5, 1931, No. 2, p. 162), who present data in tabular form and in the form of pressure-solubility plots for temperatures of 0, 10, 18, and 25 deg. C. These data may be expressed closely by the empirical equation:

$$S = p\, e^{(-0.039788\, t\, -\, 7.8153)}$$

where $S$ is the solubility of $CO_2$ in per cent when the partial pressure of $CO_2$ is $p$ mm. of mercury and the temperature is $t$ deg. C.

The equation may be readily solved by means of the accompanying alignment chart, and, as an illustration of its use, the broken line indicates that the partial pressure of carbon dioxide over a 0.15 per cent solution at 16 deg. C. is 600 mm.

# EQUIPMENT NEWS
## FROM MAKER AND USER

### Improved Rotary Dryer

TO OVERCOME mechanical difficulties inherent in the usual double-shell rotary dryer, Louisville Drying Machinery Co., Louisville, Ky., has recently perfected what is called the Type L machine. This is a direct-heat, rotary, tubular dryer in which the customary central tube is replaced by a number of specially shaped, box-like conduits, longitudinally attached to the inside of the dryer shell, as appears in Fig. 1.

Construction of the new dryer is briefly as follows: The dryer consists of a steel shell supported on tires and rollers. Within the shell are the several longitudinal conduits, so supported as to permit free lengthwise expansion. They are closed at the feed end but connected with ports in the periphery of the shell. A refractory or refractory-

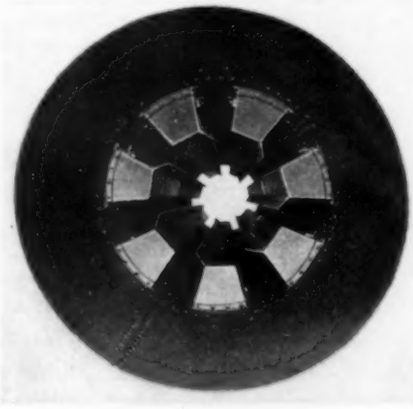


**Fig. 1—Interior of Dryer Shell Showing Conduits and Lifting Flights**

lined casing, shown in Fig. 2, surrounds the feed end of the shell and connects the ports with the furnace. The interior of the shell is separated from this casing by a metal seal ring which connects the shell to the exhaust fan and stack.

The conduits are separated from the shell by a dead air space to minimize radiation losses. They are open at the discharge end to permit return of the gases through the shell. As is shown in Fig. 1, they carry flights for lifting and cascading the material undergoing treatment. Since both feed and discharge ends are totally unobstructed, any sort of feed and discharge equipment may be used.

Wet material enters at the point of discharge of the gases, and, because the latter are at low temperature and high humidity, the feed is first heated

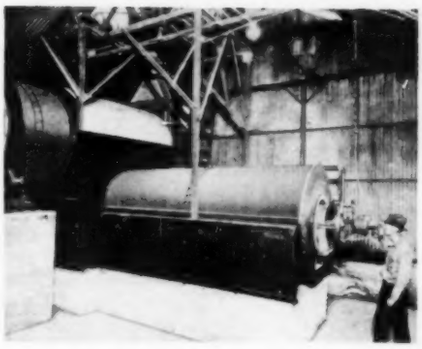


**Fig. 2—Furnace End of Dryer Showing Inlet Gas Casing and Exhaust Stack and Fan**

without appreciable evaporation, thus preventing balling through case-hardening of the material. As the shell at this point is externally heated by the hot gases about to enter the conduit, material cannot stick to the shell. Material then passes into the conduit region, where the cascading effect and long contact with the very extensive heating surfaces accomplish rapid and complete drying.

In an installation of this machine which the editors have had an opportunity to examine, a difficultly dried, puttylike material is being handled very successfully. In an ordinary double-shell dryer, this material sticks to cold surfaces, balls badly, and comes out in the form of large masses very difficult to crush. In the Type L dryer, these troubles are eliminated and the product is quite finely granular. The operating data and heat balance for this installation, given in the tabulation, are

**Operating Data and Heat Balance**

| | |
|---|---|
| **Dryer size** | 60 in.x40 ft. |
| **Wet feed:** | |
| Weight | 7,500 lb. per hour |
| Moisture | 51 per cent |
| Temperature | 68 deg. F. |
| **Dry discharge:** | |
| Weight | 4,370 lb. per hour |
| Bone dry basis | 3,675 lb. per hour |
| Moisture | 16 per cent |
| Temperature | 150 deg. F. |
| **Evaporation** | 3,130 lb. per hour |
| **Gas temperatures:** | |
| Entering dryer | 1,420 deg. F. |
| End of conduits | 380 deg. F. |
| Dryer exhaust (dry bulb) | 200 deg. F. |
| Dryer exhaust (wet bulb) | 164 deg. F. |
| **Fuel supply*** | 4,110,000 B.t.u. per hour |
| **Theoretical heat requirements,** | 3,515,000 B.t.u. per hour |
| **Thermal efficiency,** | $\frac{3,515,000}{4,110,000} = 85.5$ per cent |
| **Loss to exhaust gases,** | 304,000 B.t.u. = 7.4 per cent |
| **Loss to radiation (difference),** | 291,000 B.t.u. = 7.1 per cent |

*27.4 gal. fuel oil at 150,000 B.t.u. per gal.

based on the average of two weeks' continuous operation and support the manufacturer's claim to high capacity and remarkable thermal efficiency. It has been pointed out that the job being done by this 5-ft. machine would require a 6-ft. concentric-tube dryer.

Among further advantages claimed for the new construction may be mentioned the obvious one of decreased upkeep and easier maintenance. Suspension difficulties encountered with a heated central tube are eliminated. Gas passages are large, gas velocities low, and dust losses are thereby minimized. The dryer is said to be largely self-adjusting to load fluctuations, thus simplifying operation. Since there is no central tube, there can be no passage of the return gases through a region unobstructed by cascading material. Such short-circuiting is said to be the prime cause of inefficiency in the double-shell dryer.

❖

### Disk Feeder

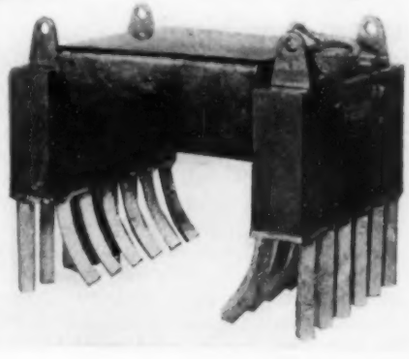
METERING of crushed and ground materials is said to be accurately handled with the "Concenco" disk feeder manufactured by the Deister Concentrator Co., 901 Glasgow Ave., Fort Wayne, Ind. A rotating, 60-in., renewable steel disk is supported on a cast-iron spider and driven through reducing gears. The disk operates horizontally beneath a cylindrical bin outlet in the side of which is set a plow adjustable for any capacity. Among the features of the device may be mentioned the fact that the drive is fully inclosed; the machine can handle feeds up to 3-in. cubes; and all wearing parts are readily renewable.

❖

### Spout Magnet for Liquids

REMOVAL of iron from liquids and suspensions such as clay slips, glazes, lacquers, and paints may be accomplished with a new spout-type magnetic separator now being offered by the

**Magnet for Removing Iron From Liquids**

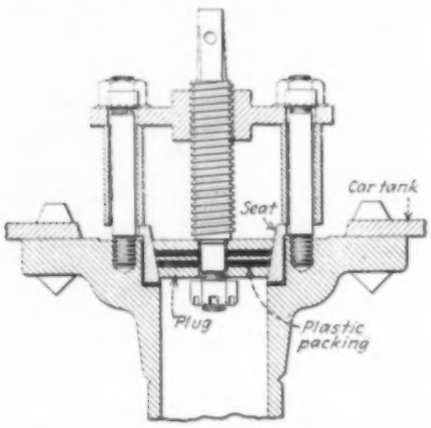


Dings Magnetic Separator Co., Milwaukee, Wis. The device consists of an electromagnet of high intensity which is suspended above a launder. Prongs dip into the launder and remove iron particles which are later released periodically as the magnet is swung out of the spout. Magnets are available in any width desired.

❖

## Improved Bottom-Outlet Valve

GENERAL AMERICAN Tank Car Corp., Continental Illinois Bank Building, Chicago, Ill., has developed an improved tank-car bottom-outlet valve, the principal features of which are shown in the accompanying sketch. The heart of the improved valve is a new,




**Detail of New Bottom-Outlet Valve**

synthetic, elastic packing material which is somewhat similar to rubber in physical characteristics, but which is unaffected by the action of hydrocarbon oils. Two sheets of this material are loosely held between the three tapered disks of the valve plug. When the plug is screwed tight against the seat, the packing material tends to squeeze out and thus forms a perfectly tight seal, regardless of the condition of the seat or of any solids that may be deposited on it.

A unique feature of this valve lies in the provision that has been made for long life and low maintenance through limiting the squeezing that can be applied to the resilient disks. Reference to the drawing will show that excessive compression is impossible because of the ultimate contact of the metal disks with the seat.

❖

## Bin-to-Bin Shipping Container

NO SPECIAL overhead handling equipment is required with a new form of shipping car body recently demonstrated at the plant of the Mount Vernon Car Manufacturing Co., Mt. Vernon, Ill. This car body, the invention of G. R. Meyercord, of the Illinois Manufacturers' Association, makes possible actual bin-to-bin delivery of merchandise without equipment other than the car body itself and a special motor truck developed by the International Harvester Co. The result is accomplished by equipping the car body with air-operated wheel jacks upon which the car body is raised and lowered. In transit on the flat car, the container rests directly on the car floor, where spring hold-down clamps prevent its shifting. The special motor truck is equipped with an elevating platform which also can be tilted. Hoisting equipment on the truck, together with an air compressor operated by the latter, serves to load the container onto the truck and from there onto the car.

❖

## Electric Steam Generators

STEAM at pressures of 100 or 200 lb. may be produced with a line of electric steam generators recently announced by the General Electric Co., Schenectady, N. Y. The standard unit consists of a suitable steel container in which one or more helical immersion heaters are inserted. The generator is provided with standard boiler fittings, including an automatic pressure governor, a low water alarm, and an automatic shut-off switch, making the equipment completely automatic in operation.

Units are available with generator shells of numerous different standard sizes. Any size shell can be provided for pressure of either 100 or 200 lb. Units are designed to operate on voltages ranging from 115 to 440 direct or alternating current.

❖

## Light Sensitive Cell

PHOTOELECTRIC action of a new sort is found in the "Photronic" cell which has recently been announced by the Weston Electrical Instrument Corp., Newark, N. J. The new device differs radically from all previous photoelectric apparatus, consisting simply of a highly light-sensitive disk which transforms light energy directly into electrical energy without the use of any auxiliary voltage. It is said to deliver about 1 micro-ampere per foot-candle of light intensity. The Photronic cell is inclosed in a molded Bakelite case, fitted at the bottom with connection prongs for mounting in an electrical circuit. It is capable of operating relays without the use of auxiliary apparatus or batteries.

The first use to which the Weston company has put the cell is in a light-measuring device, known as the "Illuminometer." This consists of an indicating instrument and a light target assembled in a portable case. The target employs two Photronic cells mounted side by side. The indicating ammeter is calibrated in foot-candles for use in measuring the intensity of illumination. It is said it is possible with this device to make a light survey in about one-tenth the time previously required.

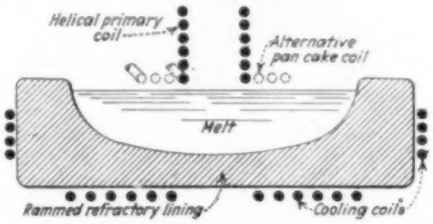
**Illuminometer With Two Photronic Cells**

❖

## Modified Induction Furnace

ENLARGEMENT of the sphere of application of the high-frequency or coreless induction furnace, through a modification in design, has recently been announced by the Ajax Electrothermic Corp., Trenton, N. J. In the standard Ajax-Northrup furnace, a helix of water-cooled copper tubing forms the primary circuit. The charge or melt, which is contained within a refractory crucible or lining, acts as the secondary. It is the current induced in the secondary, which supplies the heat required for melting.

Recently attempts have been made to keep molten such non-metallic conducting materials as iron oxide, $Fe_2O_4$. This can be accomplished by direct induction, provided that the oxide is melted to make it electrically conducting before it is charged into the induction furnace. It has been found, however, that almost all refractory linings are




**Alternative Primary Coils for Modified Induction Furnace**

either destroyed in contact with the molten oxide, or at least contaminate it. To obviate this difficulty, linings of rammed granular iron oxide have been used successfully, provided that the primary coil is placed above the melt, rather than around it. This assists in keeping the lining cool. Two alternative methods, used either separately or in combination, are shown in the accompanying illustration. The use of cooling coils, not connected into the electrical circuit, assists the cooling of the lining and permits it to remain intact. The same method is said to be equally applicable with other non-metallic materials which conduct electricity when in the molten state.

❖

## Acidproof Jointing Material

"VITROBOND" is the name given to a new sulphur-base compound for producing joints in acidproof brick tanks, recently put on the market by the Atlas Mineral Products Co., Mertztown, Pa. The bonding material is

described as impervious to hot and cold acids such as sulphuric, acetic, lactic, and hydrochloric. Tensile strength is said to be many times that of sulphur. The material is supplied in ingots weighing 10 lb. each. These are melted at a temperature above 235 deg. F. and the melted material poured between the acidproof bricks used for the tank. Tanks of this character are said to be easily constructed and very permanent. According to the manufacturer, as long as the temperature of the tank contents does not exceed 220 deg. F., neither the tank not the joints will deteriorate.

❖

## Gas-Drive Tiering Truck

FOUR-WHEEL steering and rear-wheel drive are obtainable in a new gasoline-operated tiering truck made by the Clark Tructractor Co., Battle Creek, Mich. The turning radius is 94 in. and the truck is said to operate readily in 64-in. aisles. The hydraulic lifting mechanism will tier 3 tons to 4 ft. in 18 seconds in the low-lift model, and in the high-lift model, will tier 3 tons to 6 ft. in 30 seconds.

❖

## Welding Fittings

SEVERAL new welding fittings have recently been announced by the Midwest Piping & Supply Co., 1450 South Second St., St. Louis, Mo. The line includes 90-deg. and 45-deg. ells made in sizes to 16 in. and welding heads, sleeves, and saddles in sizes to 24 in. The ells are characterized by the use of a particularly long tangent (i. e., the straight section after the bend) which is said to reduce time and cost of installation. The same feature is found in the heads and here presents the additional advantage of removing shear and bending stresses from the environment of the weld. The sleeves and

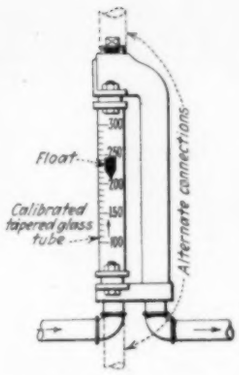
**Welding Saddle for Header Reinforcement**

saddles are used for strengthening welds, the former being used to reinforce an ordinary butt line joint and the saddle, the junctions in a welded header.

❖

## Novel Flow Meter

LIQUID and gas flows are measured readily with a simple form of flow meter which has recently been added to the line of Schutte & Koerting Co., Philadelphia, Pa. The instrument, known as the Rotameter, is made in two types, one a through-flow and one

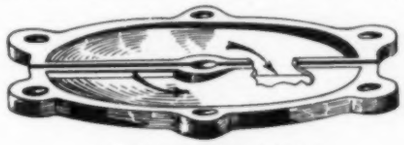



**Through-Flow Rotameter**

an orifice model. In the through-flow type, illustrated here, all of the fluid passes through the meter. In the orifice type, part of the flow is bypassed around an orifice and through the flow meter. The former type handles, in one of its several models, flow in any size pipe, while the latter is used only in pipes of 4 in. diameter or larger.

Briefly, the liquid or gas is passed upward through a slightly tapered glass tube, with the smaller end at the bottom, causing a specially shaped float to assume a balanced position dependent on the flow. Position of the float is then viewed with reference to the calibration marks on the tapered tube.

This company has also announced an interesting heat exchanger, the "Poly-



**Heat Exchanger Plate**

plate," which is of the "filter-press" type. It is built of a number of plates similar to that shown in the sketch, so designed that the two fluids flowing through the assembly follow spiral paths, separated only by a thin spiral diaphragm. By choosing the required number of plates, exchangers of any length may be built up.

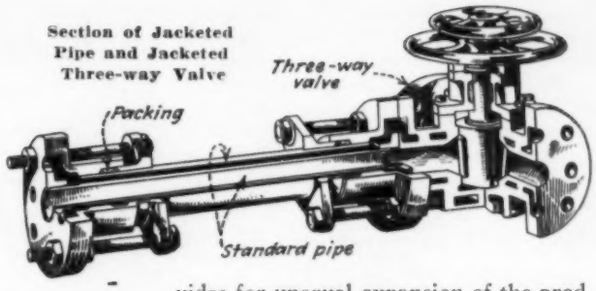
❖

## Jacketed Pipe and Fittings

ELIMINATION of all bypassing around fittings in steam jacketed lines for the conveyance of materials which must be held at an elevated temperature is said to be an outstanding feature of the line of jacketed pipe fittings and valves recently announced by Guyton & Cumfer Mfg. Co., 4451 Fillmore St., Chicago, Ill. How this is accomplished is shown clearly in the accompanying drawing, which illustrates, in partial section, a length of jacketed pipe joined to a jacketed plug valve.

Another important feature of this method is the fact that it employs standard pipe. The inner pipe, used to convey the material, is threaded into the special coupling supplied, while the outer pipe, used to convey the steam or other heating medium, is secured by a packing gland. This construction pro-

**Section of Jacketed Pipe and Jacketed Three-way Valve**




vides for unequal expansion of the product and heating lines.

The company is prepared to supply various jacketed fittings, including full- and half-expansion couplings, 45-deg. and 90-deg. ells, tees, crosses, and filler sections. Its jacketed valves, which incorporate a special tightening feature for the plug, are available in several standard patterns. The company also supplies a gear-type pump which makes use of complete steam jacketing.

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## Corrosion-Resistant Coating

MAXIMUM protection against all acids, alkalis, salts, parasites, and other destructive agencies is said to be afforded by "Liquilox," a new liquid protective coating recently developed by the Liquilox Co., Ltd., 576 Subway Terminal Bldg., Los Angeles, Calif. The coating is produced from an ore mined in western United States and contains no dyes, lampblack, rosin, asphalt, gilsonite, or animal or vegetable oils. It may be applied with a brush or spray gun to either hot or cold surfaces.

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## Operation Recorder

AUTOMATIC recording of the performance of any machine, where this performance can be expressed as a function of machine speed, such as revolutions per minute, feet per minute, cycles per hour, and so on, is made possible with a new recording tachometer recently introduced by the Amthor Testing Instrument Co., 309 Johnson St., Brooklyn, N. Y. The instrument is entirely mechanical in operation, making use of a centrifugal governor movement, driven from the machine by means of a belt or shaft drive and operating the recording pen through a linkage. Records are made on an 8-in.

**Centrifugal-Type Operation Recorder**

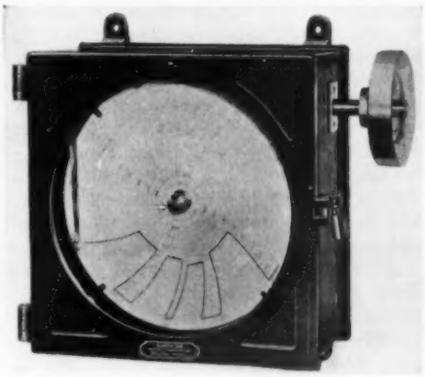

chart revolving once in 12 or 24 hours. Records of the device may be interpreted to show speeds and rates of production, changes in speed, starting and stopping time, slowdowns and nonproductive periods. The manufacturer declares that the records permit increase in efficiency and cutting of costs.

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## Chlorine Comparators

CONTROL of chlorine and pH in water, sewage, industrial wastes, bleaching and sterilizing solutions, and so on, is possible with the new line of chlorine comparators recently developed by W. A. Taylor & Co., 872 Linden Ave., Baltimore, Md. All members of the line are of similar construction, consisting of a Bakelite slide and base. The base contains a slot in which the slide moves back and forth, two holes containing vials of solution, and three holes containing tubes holding the sample to be tested. The slide contains nine color standards alternating with ampoules of distilled water. Operation of the sets is similar to that of other slide comparators. Depending on the service desired, the standards are marked either in pH units or in parts-per-million of chlorine.

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## Pulsation Absorber

PRESSURE GAGE protection is the function of a new all-welded pulsation shock absorber developed by the Meriam Co., 1956 West 112th St., Cleveland, Ohio. The device consists of a small chamber which acts as an air receiver, within which is coiled a large quantity of fine tubing. Pressure reaches the gage by passing through the chamber and thence through the friction tubing, with the result that fluctuations are said to be very completely absorbed. The device is made for line pressures up to 10,000 lb., is 7 in. high, and has no moving parts.

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## Insulation Support

CORRECT pipe insulation alignment is said to be permanently assured through use of a new pipe insulation support which has been designed by the American District Steam Co., North Tonawanda, N. Y. It is pointed out that in conventional methods, the insulation hangs on the pipe, permitting the insulation to sag and reducing insulation effectiveness. The new support cradles the pipe covering on wide brass bands, each of which is hung from a saddle passing through the insulation and resting on the pipe. These supports are available in pipe sizes up to 24 in.

This company has also developed a new protective paint for pipes. It is said to be impervious to any degree of heat generated by steam and to be practically immune to the action of moisture, dilute acids, and alkalis. While the coating is hard and tenacious, it is said to be sufficiently elastic to expand and contract with the pipe.

# Manufacturers' Latest Publications

**Burners.** Enterprise Oil Burner Co., 2902 19th St., San Francisco, Calif.—Bulletin of 32 pages describing this company's oil burners for domestic and industrial use.

**Chemical Stoneware.** General Ceramics Co., 71 West 35th St., New York City—Bulletin X—8 pages briefly illustrating types of acid-proof chemical stoneware equipment made by this company.

**Condensers.** Thermal Engineering Co., 701 Spring Arcade Bldg., Los Angeles, Calif.—Folder of 4 pages on convertible ammonia condensers.

**Control.** Powers Regulator Co., 2720 Greenview Ave., Chicago, Ill.—Bulletin 260—8 pages on a new self-operating temperature regulator for heating systems, used with unit heaters, domestic, commercial and industrial radiation.

**Electrical Equipment.** General Electric Co., Schenectady, N. Y.—Publications as follows: GEA-821B, Pressure and vacuum switches; GEA-1486, Outdoor oil circuit breakers; GEA-1516, Inclosed air circuit breakers; GEA-1519, Grid-type field rheostats; GEA-1522, Motor starting switches.

**Equipment.** F. J. Stokes Machine Co., Tabor Road, Olney P. O., Philadelphia, Pa.—Bulletin 100—Folder describing the range of process-plant equipment made by this company.

**Equipment.** Dust Recovery, Inc., 15 Park Row, New York City—8 pages on the "Vortex" dust catcher made by this company.

**Furnaces.** W. S. Rockwell Co., 50 Church St., New York City—Catalog 322—Folder describing this company's electric or fuel-fired rotary hearth furnaces.

**Heat Exchange.** Schutte & Koerting Co., Philadelphia, Pa.—Bulletin 11-S—8 pages on extended-surface radiation tubing; and coils, units, and radiators assembled from this tubing.

**Heating.** Niagara Blower Co., 6 East 45th St., New York City—Bulletin 30—4 pages describing a new disk-type fan heater of solid welded construction built entirely of aluminum. Heater also available with copper-fin-tube heating surfaces.

**Instruments.** The Bristol Co., Waterbury, Conn.—Catalog 4001—24 pages, completely describing the "Free-Vane" air-operated recorder controllers for pressure and temperature made by this company.

**Instruments.** Mine Safety Appliances Co., Pittsburgh, Pa.—Folder describing two new styles of portable, continuous indicators for carbon monoxide.

**Instruments.** Roller-Smith Co., 233 Broadway, New York City—Bulletin 160, 12 pages on portable alternating-current instruments; Supplement 1, Catalog 48, Mounting base for small instruments; Supplement 1, Bulletin 240, Surface-tension balance for measuring surface tension of liquids; Supplement 2, Bulletin 300, new circuit tester for determining presence of short-circuits and for measuring resistance of lines.

**Metals and Alloys.** Republic Steel Corp., Massillon, Ohio—43-page booklet on numerous steel shapes and on styles of structural tubing produced from reclaimed rail steel; also booklet on use of Stainless alloys in dairies and similar industries.

**Metal Protection.** Spraco, Inc., 114 Central St., Somerville, Mass.—30-page catalog and price list on spray painting and finishing equipment made by this company.

**Meters.** Ralph N. Brodie Co., 61st & Lowell Sts., Oakland, Calif.—Folder describing meters for precision measurement of flowing liquids, in capacities to 1,000 gal. per minute.

**Models.** H. E. Boucher Mfg. Co., 150 Lafayette St., New York City—24 pages on scale models of all types made by this company.

**Motors.** Century Electric Co., 1806 Pine St., St. Louis, Mo.—Bulletin 6-3—4 pages on slip-ring induction polyphase motors, ½ to 250 hp.

**Motors.** Master Electric Co., Dayton, Ohio—20-page catalog with engineering data and description of geared-head motors in small sizes for speed reduction and acceleration.

**Motors.** Wagner Electric Corp., St. Louis, Mo.—Bulletin 167—30 pages on small motors, describing single-phase, polyphase and direct-current motors of fractional horsepower ratings.

**Paper Mills.** V. D. Simmons, Inc., 435 North Michigan Ave., Chicago, Ill.—47-page brochure illustrating this company's design and construction of paper mills, briefly explaining in simple manner pulp and paper manufacture. Also describes a proposed joint utility-industrial power development believed by this concern to be of much value to industry and labor alike.

**Piping.** Air Reduction Sales Co., Lincoln Bldg., New York City—24 pages on the production of welded piping, "tailored to fit."

**Power Transmission.** Link-Belt Co., 910 South Michigan Ave., Chicago, Ill.—Folder 1260—Describes briefly a newly developed ⅜-in. pitch silent chain for miniature power drives.

**Power Transmission.** Reeves Pulley Co., Columbus, Ind.—Catalog 99—74 pages on variable-speed transmissions made by this company; includes construction details, designs for remote and automatic control, data on typical installations, and complete engineering data.

**Protective Coatings.** Sleight Bituminous Products Co., Keyser Bldg., Baltimore, Md.—Folder describing this company's line of acid-, alkali- and water-resistant bituminous coating materials, made in colors and black.

**Pumps.** De Laval Steam Turbine Co., Trenton, N. J.—Catalog B-3—12 pages on balanced, single-suction centrifugal pumps.

**Pumps.** Pennsylvania Pump & Compressor Co., Easton, Pa.—Bulletins 216 and 217—Respectively 16 and 8 pages on multi-stage centrifugal pumps and single-stage, close-coupled centrifugal pumps.

**Pumps.** Tabor Pump Co., 288 Elm St., Buffalo, N. Y.—Bulletin L-630, Type L single-suction centrifugal pumps, capacities 15 to 2,000 g.p.m.; Bulletin 120-B, 8 pages on standard sump pumps for drainage water and sewage.

**Pumps.** Worthington Pump & Machinery Corp., Harrison, N. J.—Publications as follows: Specification Sheet D-412-S6, Horizontal duplex power pumps; W-205-S1A, Specifications for double-unit steam-air ejectors; W-205-S2, Specifications for single-unit steam-air ejectors.

**Refractories.** McLeod & Henry Co., Troy, N. Y.—Catalog 232—8 pages on "Carbex" silicon carbide refractories for lining boilers, industrial furnaces, kilns, retorts, muffles, etc.

**Research.** Adam Hilger, Ltd., 24 Rochester Pl., Camden Rd., London, N.W.1, England—Fifth Edition, 1931—60-page book on the practice of spectrum analysis. Includes notes on emission spectra.

**Research.** Podbielniak Analytical & Research Laboratories, 12th floor, Medical Arts Bldg., Tulsa, Okla.—Publications as follows: Circular 4, Announcing this company's "Standard Precision Apparatus, Model-A" for low-temperature fractional distillation analysis, new thermos containers, containers for gas and gasoline samples, and packless valves; Circular 5, Describing services in construction of special scientific apparatus and in glass blowing; Circular 6, Describing analytical, consulting and research services and facilities offered by this company; also Price Lists 40 and 60, on apparatus supplied by this company.

**Screens.** Orville Simpson Co., 1230 Knowlton St., Cincinnati, Ohio—Folder describing the use of Rotex screens in making baking powder and other products.

**Steam Generation.** Edge Moor Iron Co., Edge Moor, Del.—Bulletin 70—Handsomely illustrated 26-page book describing the water walls and air preheaters manufactured by this company.

**Steam Traps.** Armstrong Machine Works, Three Rivers, Mich.—First issue of a new house organ published by this company and devoted to the use of steam traps in industry.

**Valves.** Chapman Valve Mfg. Co., Indian Orchard, Mass.—4-page folder describing a lubricated plug cock recently introduced by this company.

**Valves.** Homestead Valve Mfg. Co., Coraopolis, Pa.—48-page reference book on valves manufactured by this company.

**Valves.** Reading-Pratt & Cady Co., Bridgeport, Conn.—16-page book on the new "Lubrotite" lubricated gate valves made by this company.

**Water Conditioning.** Buromin Co., 309 Bowman Bldg., Pittsburgh, Pa.—Folder describing services of this company in supplying "Buromin" water-conditioning reagent and in installing the Hall Laboratories' methods of boiler-water conditioning in small plants.

**Weld Fittings.** Bonney Forge & Tool Works, Allentown, Pa.—8 pages on welding nozzles for making welded tee junctions, the side pipe to be welded or threaded to the nozzle.

**Wire Cloth.** Cambridge Wire Cloth Co., Cambridge, Md.—Folder describing Stainless steel wire cloth, wire screens, and wire belts made by this company.

# NEWS *of the* INDUSTRY

## Henderson Sales Bill Being Revised

FOLLOWING a conference with representatives of the Manufacturing Chemists' Association, American Medical Association, and American Drug Manufacturers' Association, Prof. Yandell Henderson, of Yale, is rewriting the bill sponsored by Senator Bingham to subject the sale of poisonous volatile substances to federal regulation under a permit system. The bill as amended probably will be restricted in scope to chemicals, paints, varnishes, lacquers, and other packaged products suitable for household use and possibly mechanical refrigerators. This revision would remove the principal objection of the bill that, as it now stands, would limit the issuance of permits for substances suitable for domestic use without endangering human life, thus barring from shipment in interstate commerce many chemical products essential to industry that have no application within the home. Senator Bingham announced that the substitute bill would be introduced shortly and that hearings will be requested before the Senate Committee on Agriculture.

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## Hydrogenation Plant Runs For Record Period

THE heavy oil hydrogenation plant at the Bayway refinery of Standard Oil Co. of New Jersey has operated continuously without interruption for eight months. This record without shut down of the first American full commercial-scale unit represents an achievement in chemical engineering of which the development engineers appear justifiably proud. During the period in question this continuous operation has been maintained despite one or two power failures by substituting plant-generated power, despite the usual number of "tuning up" problems and, according to the engineers in charge, without any serious complications.

Reports from European practice and the use of hydrogenation equipment by the I.G. indicate a variety of conditions met in Europe. The original German plant was designed to hydrogenate brown coal (lignite). Later it became desirable to hydrogenate also the tar and oil manufactured in the course of the low-temperature distillation of this lignite. Still more recently significant quantities of heavy fuel oil have become available from newly developed German petroleum. All of these three raw materials have been successfully hydrogenated. The aggregate production of motor fuel by hydrogenation is reported to equal approximately 15 per cent of the entire consumption of gasoline in Germany. Thus it is evident that hydrogenation is already a highly significant part of the liquid fuel manufacturing activity of the Reich.

The Standard Oil Co. of New Jersey also has been employing the hydrogenation process in investigations looking toward the development of a fuel which would minimize the fire hazard in aircraft operation. It is reported that the new fuel, as developed at present, has been tested in the laboratories of the National Advisory Committee for Aeronautics at Langley Field, Va. The tests are said to have been very favorable, not only in demonstrating the safety value of the product but also in proving that it develops greater power than does the ordinary aviation gasoline.

## Synthetic Acetic Acid Plant in Germany

Our consul general at Frankfort-on-the-Main has forwarded a report which states that the Lonza - Werke Elektrochemische Fabriken of Waldshut, Baden, German subsidiary of a large Swiss concern, has recently opened a new synthetic acetic acid plant not far from the German-Swiss border which is to operate outside of the German synthetic acid syndicate.

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## Ceramic Short Course At Illinois

THE biennial ceramic short course at the University of Illinois will be given Jan. 25 to Feb. 5, 1932. No fee will be charged for the course and the program will be divided into three divisions, as follows: structural clay products; bodies and glazes; and vitreous enamels. The first week of the course, Jan. 25 to Jan. 30, inclusive, will be devoted exclusively to structural clay product subjects. The course in bodies and glazes and the course in vitreous enamels will be given the second week, Feb. 1 to Feb. 5, inclusive.

## Textile Chemists Stress Value of Research

WITH an attendance of more than 300 members and visitors engaged in various branches of textile manufacture, the eleventh annual meeting of The American Association of Textile Chemists and Colorists was held in Boston, Mass., Dec. 4-5. Technical papers on various subjects brought out the importance of research activities. Dr. Louis Olney, of Lowell Textile Institute, chairman of the research committee, announced that there are now eighteen subcommittees working on some definite problem confronting the textile chemist and colorist.

P. J. Wood, vice-president and general manager of the Oriental Silk Printing Co., Paterson, N. J., was reelected president. Other officers named in the annual election are: W. H. Cady, of the U. S. Finishing Co., Providence, and Alexander Morrison, of the American Woolen Co., vice-presidents; Harry R. Davies, Dyestuffs Corporation of America, Boston, treasurer; and A. Newton Graves, Franklin Process Co., Providence, secretary. William R. Moorehouse, National Aniline & Chemical Co., and Dr. Walter M. Scott, of the Gustavus J. Esselen organization, Boston, were selected as councilors for three-year terms.

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## Lauer Elected President Of A.S.M.E.

AT the opening of the fifty-second annual meeting of the American Society of Mechanical Engineers, held in New York City, Nov. 30, it was announced that Conrad N. Lauer, president of the Philadelphia Gas Works, had been chosen president of the organization. Balloting had been conducted by mail, and other officers elected included Robert M. Gates, William B. Gregory, Fred H. Dorner, and Charles M. Allen, vice-presidents; and Eugene W. O'Brien, Harry R. Westcott, and Alexander J. Dickie, managers.

In addition to technical and business sessions, the society's gold medal was awarded to Albert Kingsbury, of Philadelphia. Mr. Kingsbury also was given one of the John Scott medals. Other winners of John Scott medals were Albert H. Emery, Jr., of Stamford, Conn., and Willis H. Carrier, of Newark, N. J. The Melville medal was awarded to Arthur E. Grunert, of Chicago.

# NEWS FROM WASHINGTON

*By Paul Wooton*

*Washington Correspondent of Chem. & Met.*

UNLESS further complications arise, the increased freight rates authorized by the Interstate Commerce Commission probably will become effective Jan. 1. In its revised list made public Dec. 7 the commodities previously earmarked for increases of $3 and $6 per car will, in general, pay 6c. and 12c. per short ton respectively. In applying the surcharges, conversion to a weight basis was suggested by the railroads because cars vary in size. The shift from a per-car to a per-ton basis produces, for the most part, the same equivalent in charges collected from shippers, but in some instances a change in classification has further increased rates.

Pulpwood, coal, coke, iron ore and copper, lead and zinc ore and concentrates, formerly listed for an increase of $3 per car, will take an increase of 6c. per ton, but ores and concentrates n.o.s., to which the surcharge of $3 per car was originally applicable, now are divided between the 6c. and 12c. per ton classifications. Included under 6c. are borate rock, bituminous rock, bituminous asphalt rock, iron pyrites, crushed or ground limestone, dolomite n.o.i.b.n., feldspar, fluorspar, fluxing stone, ganister rock, glass sand, crude gypsum, loam, molding sand, nickel matte, ore residue; crushed, ground or scrap slate, and volcanic ash. Mill cinder and mill scale (iron or steel), pyrites cinder, refuse or dross, coal ashes and cinders, and brickbats and brick dust have been converted from a $3 per car to a 6c. per ton basis.

MINERAL products that have been transferred from the $3 per car (6c. per ton) list to the 12c. per ton list include bentonite, china clay, ground flint, fireclay, gilsonite, ground gypsum (not calcined), kaolin, barium sulphate, ground (barytes), not precipitated; barium sulphate, ground precipitated (blanc fixe); crude magnesium sulphate or kieserite, mica scrap or screenings, pipe clay, shale, slate not crushed, ground or scrap; ground soapstone (talc) dust, lump or rough slabs, crude chalk, and clay n.o.i.b.n.

Forest products, n.o.s., were previously listed, as a whole, for an increase of $3 per car (6c. a ton). In the revised schedule, the list that will take an increase of 12c. per ton includes acid wood, tanbark, wood charcoal and briquets, chemical wood, brewers' or vinegar chips, cork bark, chips, dust, waste or refuse, palm kernels, and pine needles. Products previously included in the list subject to the surcharge of $6 per car that will take an increase of 12c. per ton include crude phosphate rock, sulphur, pig iron and scrap iron, and scrap steel. Asphalt and crude petroleum, previously designated for an increase of $6 per car, will take an increase of 1c. per 100 lb. Pine tar, tar and pitch except brewers' and montan, and soapstone forms and slabs, including firebox and furnace linings, have been added to the list of commodities in the 1c. per 100 lb. classification that also includes naval stores, refined petroleum, oil and gasoline, cement, brick and building tile, vegetable oil-cake and meal except cottonseed; lime and fertilizer.

ALL freight, including less-than-carload, not included in the surcharge brackets at either 6c. or 12c. per ton or 1c. per 100 lb. is subject to an increase of 2c. per 100 lb. The attempt to exempt short-haul l.c.l. freight from an increase in rates was abandoned because of the difficulty in determining the length of haul at a given rate. The increase in rates under any category is limited to 10 per cent, which applies also to switching, floatage, and lighterage charges. Where present freight tariffs are stated in dollars per car the Interstate Commerce Commission has prescribed that the increase of 1c. per 100 lb. shall become $7.50 per car; if 2c. per 100 lb., $10 per car; if 6c. per ton, $3 per car and if 12c. per ton, $5 per car.

Only one increase may be applied on through shipments moving under combination rates. The same proviso applies to shipments moving under transit on the basis of a through rate either with or without a transit or out-of-line charge. Where minimum weights are different in connection with the separate factors in combination through rates, the increase will be based on the highest minimum unless a lower total results from applying the authorized increases separately to each factor. Mixed carload shipments will be subject to the highest surcharge provided for any commodity in the car except where a lower total results by surcharging a portion of the shipment as a less than carload and the remainder as a carload. The rate increases apply to the weight on which the charges are based.

IN announcing several tariff adjustments, including a reduction of 25 per cent in duties on window (crown, cylinder, sheet) glass and from $1 to 50c. a ton on crude feldspar, effective Jan. 1, the Tariff Commission has concluded 18 months of intensive activity since its reorganization. Under the rigid discipline of Henry P. Fletcher, retired chairman, the Commission has hung up a fine record for doing little things in a big way. While adjustments in duty have been numerous they have been confined to commodities of small importance. The Commission has either recommended no change or has not yet reported on commodities, such as linseed oil and casein, that are political trouble makers.

In opposing tariff revision at this session of Congress, President Hoover expressed confidence that flexible tariff procedure offers protection against declining labor costs abroad and abandonment of the gold standard in England and other countries. In its last series of recommendations the Commission reported that because of this very fact—the disturbance of exchange and its uncertain effect upon costs—it was unable to specify a change in duties on several English and Mexican products.

Chairman Fletcher had no interest in the tariff as an institution. His sole object was to raise its mechanical efficiency. Protégé of Grover Cleveland, his successor has all the conviction of a convert in "substantial tariffs." Whether Robert Lincoln O'Brien will be as successful as Fletcher in imposing his will upon his colleagues is doubtful. He has a less forceful personality and more scruples.

IT is too early to predict the fate of the recommendation of the Muscle Shoals Commission that the properties be leased, preferably to a farmer-owned and controlled organization, for the production of commercial fertilizer and chemicals. President Hoover's only comment in making the Commission's report public was that the conclusions speak for themselves. He may have more to say when he submits the report to Congress. Advocates of government operation say that they can muster enough support to put the Norris bill through over a veto. This is regarded as very doubtful.

As the Commission does not commit itself in favor of the production of nitrogeneous fertilizers, an accompanying report by Henry G. Knight, chief of the Bureau of Chemistry, stating that Muscle Shoals possesses only meager economic possibilities for the production of nitrogen, does not give the Commission's report as Wickershamish a flavor as appears at first blush. Dr. Knight suggested that Muscle Shoals might possibly prove to be a good place to make phosphoric acid and that possibly the best test of this would be to seek bids for use of the plant for this purpose.

No increase has been noted in chemical competition from Great Britain since that country abandoned the gold standard but the statistics available relate only to the month of October. Scrutiny of imports in ensuing months will be necessary to determine whether the depreciated pound will have the effect of stimulating British exports to the United States.

After Jan. 15 Japan will apply an import license system on all shipments of sulphate of ammonia.

## August Merz Reelected President of S.O.C.M.A.

PROTEST was voiced at the tenth annual meeting of the Synthetic Organic Chemical Manufacturers' Association, held in New York City, Dec. 10, against the proposed discontinuance of the annual census of dyes and synthetic organic chemicals published by the U. S. Tariff Commission. Charles A. Mace, secretary of the association, touched on this subject in his annual report. Dr. Charles H. Herty, at the luncheon session, stated that the discontinuance of this census was a backward step and he advocated an enlargement of this service so that more complete statistics might become available for other manufacturing industries.

John E. Edgerton, president of the National Association of Manufacturers, in speaking at the luncheon said that a fifteen-week campaign will be started Jan. 8, in which the full facts of the economic situation in the United States will be broadcast over the entire country. The purpose in this, he explained, is to get people to think out of calm deliberation and not out of their emotions. The present tariff act is not responsible for the depression, Mr. Edgerton said. Conditions which have existed since the latter part of 1929 are but the natural consequence of the overindulgence in productive endeavors based on a short-sighted belief that the United States was destined to supply all the needs of the markets of the world, because it was without competition during the years of the World War and those immediately following.

At the business session officers were elected as follows: president, August Merz, Heller & Merz Corp., New York City; vice-presidents, E. H. Killheffer, E. I. duPont de Nemours & Co., Passaic, N. J., and Frederick G. Zinsser, Zinsser & Co., Hastings-on-Hudson, N. Y.; additional members of the board of governors, E. A. Barnett, John Campbell & Co., New York; G. Lee Camp, Monsanto Chemical Works, St. Louis, and A. L. Van Ameringen, Van Ameringen-Haebler, Inc., New York.

The board of governors reelected Ralph L. Dorland, of the Dow Chemical Co., New York, as treasurer, and Charles A. Mace, New York, as secretary.

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## Further Conferences for Cosach Interests

IN CONNECTION with the report that the commission which has been investigating the nitrate situation for the Chilean government had submitted its findings, the following announcement was issued by Guggenheim Bros.:

"An invitation has been extended by the Chilean government, which has been accepted by the company, to hold in Chile further conferences with the government and with the holders of the company's obligations and others interested in the company, through which it is hoped that a permanent accord may be reached which is practicable and in conformity with the aspiration of the Chilean government and with the permanent interests of the industry.

"New financial arrangements for the company are predicated on the government's reaffirmation of the historic Chilean policy that financial obligations contracted will be respected by the government, thus evidencing again the confidence in which the undertakings of the Chilean government are held in the financial markets of the world."

At the time the company was formed the government canceled the export duties of $12.50 a ton on iodine and nitrates. This was done so that the company would not be at a trade disadvantage.

The Chilean government has been made a 50 per cent partner in the company, and is guaranteed income for 1931, 1932 and 1933 totaling about $60,000,000 to replace the amounts which would have been received in export duties.

Funds received by the company from the private sales last spring of $34,000,000 of its bonds were to be used in part for working capital and in part to meet the payment to the government. It is understood that poor business necessitated the use of more of the funds than it was expected would be needed.

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## Kavalco Files Answer In Monsanto Suit

AN ANSWER was filed by Kavalco Products, Inc., Nitro, W. Va., Dec. 1, in the federal court in Charleston, W. Va., denying allegations of fraudulent use of secret processes and breach of contract contained in the injunction suit brought by the Monsanto Chemical Works, St. Louis, Mo., and the Rubber Service Laboratories, Akron, Ohio. The answer is joined by C. Olin North and Winfield Scott, officials of the Kavalco company, who are co-defendants.

The answer categorically denies any breach of contract or fraudulent use of secret processes in connection with the manufacture of phenolphthalein, triphenyl phosphate, or tricresyl phosphate. The processes used in the Kavalco operations are declared to have been developed by the defendants subsequent to the time when Mr. North and Mr. Scott left the employ of the Rubber Service Laboratories.

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## Hydrogen Peroxide Shipped In Tank Car

SUCCESSFUL shipment of 100-volume hydrogen peroxide in a specially constructed tank car is reported to have been made by the Buffalo Electro-Chemical Co., following cooperative efforts by that company and the General American Tank Car Corp. The tank car is built of three large aluminum plates of a new aluminum alloy designated as Alloy No. 51-SW Special, which carries copper, manganese, and titanium as impurities only.

## Chemical Engineers Adopt Membership Gradation

CHEMICAL engineers will be more closely allied with the civil and sanitary engineers in the future if the recommendations discussed at the annual business meeting of the American Institute of Chemical Engineers in Atlantic City, Dec. 10, are accepted by the organizations involved. A paper by Thorndike Saville in the symposium on stream pollution had suggested that through an appropriate joint committee with the American Society of Civil Engineers, the institute should engage upon a study of industrial waste disposal with relation to stream pollution.

W. L. Stevenson, chief engineer of the Pennsylvania Department of Health, held that there is a real need for a coordinating agency to assemble and interpret these developments in somewhat the same manner as is now done on a limited scale by the Conference of State Engineers. George T. Seabury, secretary of the American Society of Civil Engineers, stated his personal view that civil and chemical engineers should be more closely allied in their studies of water pollution and sewage and waste treating methods, and also in the field of engineering materials. On motion of Prof. A. H. White, of Michigan, the annual meeting went on record as favoring such an organization and referring the matter to the council of the institute with power to act.

Other important action taken at the chemical engineers' annual meeting was the approval of a constitutional amendment setting up three kinds of membership—active, associate and junior. The first draft of this had been submitted at the Swampscott meeting by Dr. M. H. Ittner, as chairman of the committee of nine. Subsequently it had been revised, passed on unanimously by the membership committee, and must now be submitted to the ballot of the membership.

Dr. H. C. Parmelee reported that the committee on chemical engineering education was now ready to recommend one additional institution for inclusion on the list of accredited colleges and universities. His committee has also approved a statement outlining the working procedure for an institution making application for listing by the institute. Dr. Harrison E. Howe summarized an account of the institute's participation in the American Engineering Council and stated that a published report on this subject would shortly be available to the members.

A. E. Marshall, who has served as chairman of the committee to arrange the joint session in England with the Institution of Chemical Engineers, announced that because of the "economic disturbance" in both countries, the meeting would have to be postponed for one or two years. Instead the June, 1932, sessions will be held in Schenectady and Corning, N. Y.

A list of the newly elected officers of the institute appears on p. 737 of this issue.

# Tariff Changes Encourage Enlarged Production in Great Britain

## American and Continental Manufacturers Expected to Cooperate

*From Our London Correspondent*

THE RECENT general election and its favorable outcome have naturally overshadowed almost every other activity, but some time may elapse before its influence upon national life and upon the chemical industry can be viewed in proper perspective. Chemistry, engineering, and science are fairly represented among the successful candidates, Lord Reading and Dr. Clayton being directors of Imperial Chemical Industries, to mention only one example of a new member and of a Cabinet Minister. The shares of I.C.I. have naturally appreciated in value, possibly more than intrinsic value may justify, and those who look for any comprehensive tariffs as distinct from rational safeguarding are likely to be disappointed. On the other hand, it is clear that manufacturers in Europe, and perhaps in the United States, will make inquiries and preparations for licensing or carrying out of processes of manufacture, plant, and commodities hitherto imported into this country, and which might with advantage entail manufacturing operations independently, or in cooperation with existing concerns to serve the British market.

Although the Chambers of Commerce have collected information regarding factory sites and have received a number of tentative inquiries, it is clear that technical, consulting, and financial cooperation from those with a knowledge of Continental and American conditions will be sought and needed. The *Journal of the Society of Chemical Industry* has just published a special number in which details are given of the various locations in this country which are particularly suitable for factories.

INTERIM dividend of 1½ per cent paid by I.C.I., which involved a distribution of some $3,000,000, was in accordance with expectations, although it was realized that such distribution might not accurately reflect the potential earning capacity in the near future. It was clear that there was little hope of any substantial improvement in the nitrogen situation, and even exports contracted for to Russia appear to have fallen short of expectations, the quantity exported being only about 70,000 tons of ammonium sulphate.

On the other hand, confidence was stimulated by the announcement in regard to the possibilities that might be expected from the hydrogenation of coal, and to which reference was made in Dr. Ormandy's paper before the Institute of Fuel. It is evident that this path may be a long one, because the estimated capital cost is about $200 per annual ton of gasoline, so that depreciation and interest on capital would alone account for half the cost of production and would be more than the out-of-pocket cost of landing gasoline today from the United States.

The question of hydrogen supply is obviously important, and in a paper by Dr. E. F. Armstrong on the subject, which is to be presented to the Institution of Chemical Engineers, will be of interest, particularly if it devotes closer attention to the possibilities of coke-oven gas as a source of hydrogen. The protagonists of low-temperature carbonization also had their say, in spite of the somewhat defunct state of industry as a potential producer of oil and gasoline. Although the semi-coke is finding an increasing market for domestic use, it suffers from the great disadvantage of occupying about twice the bulk of round coal. Here also hydrogenation of the low-temperature tars offers a very interesting field for research and exploitation, and the same may be said of creosote and pitch.

SACCHARIFICATION of wood has been a fascinating possibility, although the price of molasses holds out slender hopes of commercial success. In a paper read before the Society of Chemical Industry, Dr. Auden and Dr. Joshua, of the research department of the Distillers' Co., presented the result of their work on a semi-commercial scale extending over many months in the plant to which visitors were admitted during the jubilee meeting of the society in July.

The rayon industry is showing definite signs of improvement and the depreciation in sterling and the possibility of a safeguarding duty have also stimulated activities in the manufacture of transparent wrapping paper of the cellophane type. Thus Messrs. Courtaulds are doubling their plant capacity, and the sales of Transparent Paper, Ltd., are on the upgrade. The British market at present absorbs some 50 tons per week and is definitely expanding, and it will be interesting to observe whether British plant capacity can be expanded sufficiently rapidly to reduce importation from Europe, amounting to fully one half of the country's requirements. Some interesting new developments in this industry are expected in the near future, and no doubt the price will ultimately fall with expanding demand and intensified competition, seeing that international price-fixing arrangements are extremely unlikely so long as Messrs. Courtaulds find the business profitable.

New methods of nickel and chromium plating mentioned in these notes some months ago have now been abundantly proved in practice and in use by important concerns in the motor and other industries. A demonstration commercial unit has been installed by Metalion, Ltd., in London, and has aroused great interest on account of the saving in time and working costs, and the improved appearance and adherence of the deposited metals.

The *Chemical Trade Journal* gives details of a proposed standard specification recommended by a technical committee of the British Engineering Standards Association for the identification of chemical pipes. It is suggested that sheet metal disks suitably colored and lettered be hung on the pipe lines to denote the nature of the fluid conveyed, according to whether they are inflammable, toxic, corrosive, valuable, or under pressure.

Sir Hugo Hirst, chairman of the General Electric Co., is the new president of the Institute of Fuel, and H. W. Cremer, lecturer in chemical engineering at King's College, London, is the new honorary secretary appointed by the Institution of Chemical Engineers in place of the late J. W. Hinchley.

SOME interest has been displayed in the N.O.C. process of the New Oscilloscope Co., by which it is asserted that corrosion and scale in boilers may be prevented. This is not an electrolytic process; it merely consists in the passing of a small current through the boiler at a pressure of a few millivolts, practically the whole of this current passing through the shell and not through the water inside it. No auxiliary purification plant is necessary and the process is also applicable to the circulating water of oil and gas engines.

It is now certain that the Dyestuffs Act will be continued, and conversations have been proceeding very actively and with certainty of success between the German I. G. and Imperial Chemical Industries, as well as other parties, in order that a definite understanding can at last be arrived at internationally as well as domestically. It is a moot point whether all these attempts to protect prices and markets will not ultimately lead, in the chemical industry at any rate, to profitable manufacture by small firms of specialized lines salable at favorable prices, owing to the absence of heavy overhead charges.

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## Ice Manufacturers Will Meet in Victoria

ICE manufacturers of the Pacific Northwest will convene in Victoria, B. C., during the latter part of January. They will assemble as members of the Northwest Ice Industries Association, which will hold its convention at Victoria under the chairmanship of President Stanley Ewing, of Seattle, Wash. Representatives of all the leading ice manufacturers in Washington, Oregon, and British Columbia will be represented at the meeting.

# Unemployment Figures Emphasize Drop in French Manufacture

## Output of Chemicals Maintained at Fairly High Level

*From Our Paris Correspondent*

INDUSTRIAL conditions in France have taken no change for the better in the last month. On the other hand, the number of unemployed is steadily increasing. Official figures have credited 60,000 people as being out of work, but this total applies only to those who are receiving assistance from official organizations. Conservative estimates place the total number of unemployed at about 400,000. The labor situation has directed attention to the fact that many foreigners are engaged in French industries. For instance, 80 per cent of mine workers are foreigners. In the agricultural sections of the Southwest, large numbers of Italians and Spaniards are employed. In the northern textile centers, Belgian workers are numerous. It is held that the labor problem would be solved if the places now held by foreigners were turned over to French workers.

It is generally hoped that the execution of the national plan, which had been suspended for reasons of a political nature, will help in lessening the number of unemployed. Provisions are being made for the execution of works of general utility amounting to some four billion francs and including the construction of bridges, ports, schools, country electrification, waterworks, etc., to afford employment for some 100,000 men. This plan, however, requires an early vote on the part of the French Parliament and a mobilization of the necessary funds, which probably will be provided by means of a national loan.

IF it is rather difficult to give adequate figures regarding the exact number of unemployed owing to a lack of reliable statistics, it is quite as impossible to determine the exact proportion in which production has been decreasing in the various industries. This varies from 10 per cent in the northern collieries to 50 per cent in the Lyons silk industry and the tanneries, which, owing to large importation of American and Czechoslovakian shoes, have, for a long time been compelled to lower their rate of operations.

In general, what may be termed luxury industries have suffered to the greatest extent from the depression. Manufacture of chemicals has been maintained at a fairly high average. Export trade in chemicals, as in other commodities, however, has been curtailed with England, because of the drop in sterling, and the same holds true for the Scandinavian countries. Financial conditions in Germany also debar that country from normal purchases of French goods. The upheaval in European exchange, therefore, may be cited as a very important factor in limiting the export tonnage of French-made chemicals and thus directly affecting the rate of productive activities.

IN contrast, French markets have been thrown open to importations from outside by reason of the position of exchange. A decree of Aug. 1, 1931, will now be put into effect. This decree provides the imposition of emergency tariffs, the rate of which has just been placed at 15 per cent, with a view of protecting French markets from competition arising from differences in exchange. In addition, a bill is now being presented, which provides that the 2 per cent tax, applied on all imports, will be increased to 4 per cent on half-finished and to 6 per cent on all finished articles, the 2 per cent being maintained only on raw materials.

Beet-sugar production, which is important in the northern section of France, has increased in recent years. The cultivated area in 1915 was 200,000 hectares and 240,000 hectares in 1930. This year production will be lower and the 800,000 tons provided in an agreement made between growers and sugar manufacturers is not likely to be attained.

Edmond Gillet, who had important interests in the Lyons silk industries as well as in the artificial silk and chemical industries, recently died. He was chairman of the board of the firm of Progil, of Lyons, which owns a number of works in various parts of France.

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## Duty on Crude Feldspar Cut in Half

THE President has approved the report of the Tariff Commission with respect to the duty on feldspar, which indicated that a maximum reduction of 50 per cent should be made in the existing rate of $1 per ton on crude feldspar but that no change should be made in the duty on ground feldspar. Under the act of 1922, crude feldspar was on the free list and ground feldspar was dutiable at 30 per cent, as at present.

Cost data for crude feldspar produced in the United States during the year 1930 were obtained from twelve domestic mines which produced 75,491 long tons, equal to 44 per cent of the total domestic production for that year and representing 75 per cent of the total production of the country for which cost records were kept.

Cost data for crude feldspar produced in Canada in 1930 were obtained from five Canadian mines which produced 16,743 long tons of crude feldspar during 1930, equal to 79 per cent of the total quantity exported to the United States during that year.

The report of the commission shows that the cost of Canadian feldspar, exclusive of the cost of grinding, but including the weighted average cost of transportation from mines to grinding mills and from grinding mills to principal markets in the United States, exceeds the corresponding cost of domestic feldspar by $2.44 per ton and that after taking into consideration the difference in price between Canadian and domestic feldspar and making allowance for the possible effect upon costs of the depreciation in the Canadian dollar, the maximum reduction in duty permitted by law, namely, 50c. per ton, is warranted.

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## Bausch and Lomb Aid Research Workers

A NOVEL method of stressing the importance of optical instruments as aids to work in research and control was employed by the Bausch & Lomb Optical Co. in the form of a course in "The Use of Optical Instruments in the Study of Chemical Problems" given at its laboratories in Rochester, N. Y., Nov. 2-14. Selected from various industries, fifteen men, prominent in research and control work in their respective companies, were invited to assemble in Rochester on Nov. 2 and take this specially arranged course covering the principles and applications of the more commonly used optical instruments. Laboratory specialists of Bausch & Lomb with Prof. E. M. Chamot, of Cornell University, made up the faculty. In addition to a well-planned course of lectures, demonstrations, and laboratory exercises, a certain amount of elective specialization on particular instruments was made possible. Specific problems of the attending scientists also were given consideration.

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## Plans to Expand Use Of Charcoal

PLANS for the publication of a bulletin to popularize the use of charcoal for industrial and domestic purposes are being carried forward by Axel H. Oxholm, director of the national committee on wood utilization, in conjunction with W. H. Matthews, president of the Forest Products Chemical Co., Memphis, Tenn., and several other manufacturers of wood chemical products. Mr. Oxholm is confident that if profitable outlets were developed for this by-product of wood distillation, the status of the industry would improve materially. He expressed the belief that a wide market for charcoal as a supplementary fuel in homes can be created.

# German Industries in Acute Crisis Submit to Decrees

## Paring of Prices Brings Domestic Distress but Foreign Advantage

*From Our Berlin Correspondent*

EVEN the I. G. Farbenindustrie complained in its last meeting of the acute depression and the crisis in consumption. Although this has had no considerable effect in the fields of dyes, pharmaceuticals, and photographic products, or even certain chemicals, the outlook is particularly dispiriting in the case of nitrogen and motor fuel, which have been the object of such long research. In order to enable agriculture to avail itself more generally of nitrogen fertilizer, prices have been cut repeatedly and in some cases are appreciably below those prevailing before the War. Nevertheless, domestic consumption continues to decrease, while a further recession will inevitably have grave consequences for the general national economy. Nor has the export of German nitrogen been able to maintain itself in the world market. Responsible causes are the tendency of most industrialized countries to erect their own nitrogen plants and the consequent closing of former markets by protective tariffs and embargos.

For these reasons, coupled with its decreased purchasing power, the I.G. will have to count on a restriction in its synthetic nitrogen production and its dependent technical and scientific operations. The motor fuel market offers no hope of return in the present contested world market, but the necessity of cultivating this branch of industry still remains, especially since it rests, like nitrogen production, on a fabrication of domestic raw materials. Through the foundation of the German distribution syndicate for rayon a certain stability has been achieved in the domestic market, although it is doubtful that a profitable production is possible at the present time anyway.

THERE has been continued pressure on chemical prices, especially in consideration of the prevailing disadvantage compared with countries operating on weakened currency. This matter, however, is also subject to the emergency decrees concerning commodity price and wage reductions that have just been enacted. An entire readjustment, for better or for worse, therefore seems imminent, although it is too early to diagnose the effects on world markets.

Through excessive mechanization of coal operations in the Ruhr, the so-called grading problem has risen to great importance through the circumstance that extraordinary quantities of fine coal have accumulated. There is no market for it at present, and the production of lump coal is concomitantly reduced. As long as the excessive quantities of fine coal were rather easily disposed of in coking, the problem did not arise; but since the coking business of the syndicate is proportionately much worse off than the coal business, the whole industry is suffering from this excessive mechanization and rationalization of the preceding era.

The Wintershall A.G., a leading potash concern, has rented a petroleum refinery which it will operate cooperatively with the firm Lepenau in Salzbergen and with Anton Raky, Salzgitter. The cracking plant already erected in Salzgitter is being dismantled by the Borsig company and re-erected in Salzbergen. Prospectively 2,000 tons of crude petroleum will be processed here.

A ray of light in the consumption crisis is the plastic resin industry, which utilizes raw materials available in practically unlimited quantities. This can now be freely expanded because American patents for resins have expired in Germany. Although a statistical analysis of the market is difficult, it is observed that German participation in the world production is rapidly climbing. During 1929 the estimated share of the world's production were: the United States, 40; Germany, 23; Great Britain, 17; and France, about 10 per cent; meanwhile it is safe to assume that the German production has risen close to the American figure. In both countries the conditions for expansion are favorable; that is, mass consumption of cheap, good-looking, insulating, durable and resistant objects for the most varied purposes; and in both countries the large electrical concerns are active in the development of fabricated products from artificial resins.

THE use of brown coal (lignite) as a fertilizer has been investigated in practical trials by Liesche, who found that the productivity of many plants, such as potatoes, tobacco and so on, can be increased by the addition of controlled quantities in the soil. By the use of large quantities of lignite, however, growth is reduced because its acid nature restricts the reducing and adsorptive power of the plant. This deleterious effect, however, can be reduced by treating the coal with ammonia first. Thermally inferior coals are quite applicable to fertilization. The action depends on the presence of humic acids in the coal which influence the permeability of the plant cells for accepting nutrition; the nitrogen content, however, has no effect. The action of the normal fertilizer is greatly increased by the slight addition of humic compounds. It is believed that the soil exhaustion that accompanies the continued use of artificial fertilizer is due to the reduction in humic compounds within the soil and can be alleviated by replacing them.

According to Prof. Falk, Hann-Münden, arsenic can be used advantageously in wood preservation processes. Arsenic, in the form of arsenates, combined with chromates or bichromates, seems to become stably fixed on application. Of especial importance was the discovery that wood, permeated with 2 per cent solution of arsenic acid and bichromate could be shaken in water several thousand times without apparently relinquishing any arsenic or chromium to the wash water. This impregnation also serves as a fire protection.

The union of German food manufacturers and dealers is in conference for the purpose of outlining a new ordinance on preservatives for food materials, in conjunction with the Public Health Bureau. The purpose is to ascertain the harmlessness of such agents as sulphurous acids, boric acid, hexamethylenetetramine, formic acid, benzoic acid, and oxybenzoic acid, as well as the best methods of application and degree of purity.

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## Insecticide Group Adopts Conference Rules

THE insecticide and disinfectant industry, which held a trade practice conference in Indianapolis, in November, 1926, has accepted the rules of that conference following a number of changes suggested by the Federal Trade Commission. The Commission divided a former resolution concerning an existing business practice into two parts. The Commission approved the rule in one part and accepted as an expression of the trade the rule in the other part.

The Group I rule refers to giving money or anything of value to agents of customers or of competitors' customers without the knowledge of their employers, as an inducement to influence their employers to purchase products from the maker of such gift, or to influence such employers to refrain from dealing with competitors. The Group II rule refers to the matter of observance by the industry of the Group I rule.

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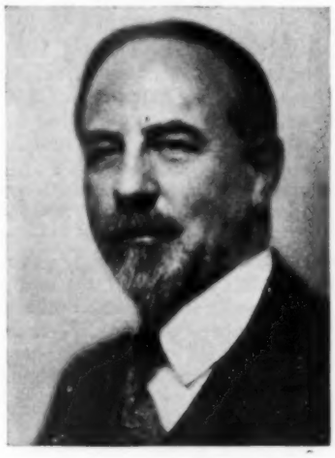
## Ice Manufacturers Will Meet in Victoria

ICE manufacturers of the Pacific Northwest will convene in Victoria, B. C., during the latter part of January. They will assemble as members of the Northwest Ice Industries Association, which will hold its convention at Victoria under the chairmanship of President Stanley Ewing, of Seattle, Wash. Representatives of all the leading ice manufacturers in Washington, Oregon, and British Columbia will be present.

# MEN
## IN CHEMICAL ENGINEERING

JOHN V. N. DORR, president of The Dorr Co., New York City, has been elected president of the American Institute of Chemical Engineers for the coming year. Mr. Dorr has been the recipient of numerous previous honors for his fundamental early work on chemical engineering equipment, of which his present company has been the outcome.



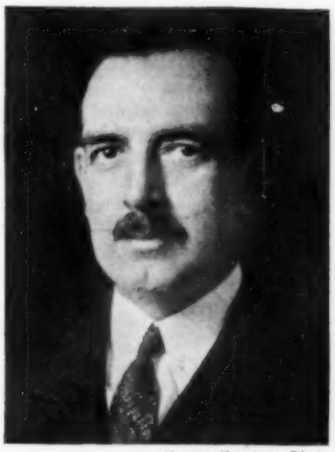
JOHN V. N. DORR

ALBERT E. MARSHALL, consulting chemical engineer, of New York City, has been elected vice-president of the American Institute of Chemical Engineers. Mr. Marshall, a native of England and a graduate of Liverpool University, has been associated with many types of chemical operations in this country, especially in heavy chemicals and glass technology. Before adopting his consulting practice, he was engaged with the United Alkali Co., London, Thermal Syndicate, and Davison Chemical Co.

WILLARD DOW, president of Dow Chemical Co.; H. C. PARMELEE, vice-president of the McGraw-Hill Publishing Co.; JAMES G. VAIL, Philadelphia Quartz Co.; and R. T. HASLAM, Standard Oil Co. (N. J.), were elected directors of the American Institute of Chemical Engineers. FREDERIC J. LEMAISTRE, MARTIN H. ITTNER, and DAVID WESSON were reelected secretary, treasurer, and auditor respectively.

ALFRED W. GAUGER, for five years head of the division of mines and department of chemical engineering at the University of North Dakota, has joined the Pennsylvania State College to become head of the Mineral Industries experiment station.

GEORGE H. FANCHER is now head of the petroleum research division of the Mineral Industries school at Pennsylvania State College. Dr. Fancher has spent much of his past career in advanced study and in petroleum companies, but came to his new position from the Colorado School of Mines, where he was associate professor of petroleum engineering.



*Kaiden-Keystone Photo*

ALBERT E. MARSHALL

WILLIAM ALBERT GALLUP, formerly of the staff of Arthur D. Little, Inc., has opened an office in Boston for consultation services involving chemical products and processes.

W. D. HUNTINGTON, for 16 years vice-president of the Davison Chemical Co., Baltimore, has resigned and will assume the directorship of fertilizer sales for the American Cyanamid Co., New York City.

WALTER S. LANDIS, vice-president of the American Cyanamid Co., has been elected chairman of the New York Section of the American Chemical Society for 1932. Dr. Landis has been with his present company since 1912, and before that spent five years teaching at Lehigh University.

ROB ROY MCGREGOR, who has been a member of Mellon Institute research staff since 1927, has been appointed incumbent of a new fellowship there, established by the Macbeth-Evans Glass Co. for research on glassware.

ARTHUR K. DOOLITTLE, for many years connected with the Sherwin-Williams Co., at Newark, N. J., is now engaged in lacquer research for the Bradley & Vrooman Co., paint manufacturers at Chicago.

CARL BOSCH and FRIEDRICH BERGIUS, both of the I. G. Farbenindustrie, of Germany, have been appointed joint recipients of the Nobel chemistry award of 1931. The award is significant in its choice of two men whose work has been identified particularly with large-scale chemical industry. Dr. Bosch was particularly successful in the commercial fulfillment of atmospheric nitrogen fixation together with Haber, who received the sole award in 1918. Dr. Bergius' greatest contribution probably was his successful hydrogenation of coal and oil, the former in Germany and the latter both here and abroad. Another recent work of his was the conversion of sawdust into sugar through acid hydrolysis.

EDWARD R. WEIDLEIN, director of Mellon Institute of Industrial Research, has been elected to the board of trustees of the University of Pittsburgh.

J. R. HOOVER, for two years manager of the general chemical laboratories of the B. F. Goodrich Co., Akron, Ohio, has joined the chemical sales division. His successor is L. M. Freeman.

R. M. BURNS has been promoted to assistant chemical director of the Bell Telephone Laboratories, New York City, under R. R. Williams, the director, as a part of the reorganization now under way in the chemical department.

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## OBITUARY

WILLIAM C. WARNER, vice-president and secretary of the Maltbie Chemical Co., Newark, N. J., died on Dec. 2, at his home in Glen Ridge at the age of 61. He had been with this company since 1893 when he joined as chemist and later became laboratory manager.

## CALENDAR

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, spring meeting, Schenectady and Corning, N. Y., June.

AMERICAN CHEMICAL SOCIETY, 83d meeting, New Orleans, March 28-April 1.

ELECTROCHEMICAL SOCIETY, spring meeting, Baltimore, April 21-23.

HEATING AND VENTILATING EXPOSITION, American Society of Heating and Ventilating Engineers, Cleveland, Jan. 25-29.

INTERNATIONAL CONGRESS OF PURE AND APPLIED CHEMISTRY, Madrid, Spain, April 3-10.

MATERIALS HANDLING EXPOSITION, New York City, indefinitely postponed.

RUBBER DIVISION, American Chemical Society, spring meeting, Detroit, Feb. 25-26.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY, New York, Feb. 15-18.

# ECONOMIC INFLUENCES

## *on production and consumption of* CHEMICALS

# Chemical Industry Operated at Slower Rate Last Month

### Productive Activities Closely Follow Lead of Consuming Industries

INCREASED rate of chemical production, which was reported for September, failed to continue throughout October and a further slight drop was reported for November. Owing to larger outputs in some of the basic industries, the index number of *Electrical World* rose slightly in November, but the chemical and other process industries did not share in this improvement. Manufacturing operations as measured by consumption of electrical power is indicated by 128.2 for November, with 129.3 representing the rate for the preceding month. Declines in the leather and textile trades accounted for a falling off in consumption of chemicals in those fields, but a part of this loss was made up by wider activities in the rubber and paper trades. Automotive activities, while not coming up to expectations, were reported at a higher rate than for October.

Comparative activities for October, this year and last year, in some of the producing and consuming branches of the chemical industry are shown as follows:

| | Oct., 1931 | Oct., 1930 |
|---|---|---|
| **Production** | | |
| Acetate of lime, 1,000 lb. | 1,529 | 5,871 |
| Methanol, crude, gal. | 183,851 | 372,939 |
| Methanol, ref. gal. | 56,474 | 575,711 |
| Methanol, syn., gal. | 510,432 | 966,469 |
| Automobiles, cars, number | 57,764 | 113,226 |
| Trucks, number | 21,727 | 40,593 |
| Taxis, number | 651 | 582 |
| Byproduct coke, 1,000 ton | 2,389 | 3,408 |
| Glass, plate, 1,000 sq.ft. | 4,532 | 8,583 |
| Glass, containers, 1,000 gr. | 1,779 | 2,347 |
| Petroleum refined, 1,000 bbl. | 75,675 | 74,018 |
| Rosin, wood, bbl. | 26,102 | 34,818 |
| Turpentine, wood, bbl. | 3,922 | 5,817 |
| Pine oil, gal. | 176,973 | 225,688 |
| Ethyl alcohol, 1,000 pr. gal. | 16,037 | 18,455 |
| Ethyl alcohol withdrawn for denaturation, 1,000 pr. gal. | 15,564 | 18,537 |
| **Consumption** | | |
| Cotton, bales | 462,025 | 443,284 |
| Silk, bales | 56,668 | 61,937 |
| Wool, 1,000 lb. gr. equiv. | 42,990 | 40,975 |
| Rubber, crude, ton. | 22,277 | 27,516 |
| Fertilizer in southern states, 1,000 tons | 94 | 106 |
| Sulphuric acid in fertilizer industry, ton | 95,478 | 222,892 |

The slower movement in the fertilizer industry this year has had a direct bearing on the total output of sulphuric acid. The fertilizer trade is by far the largest single consumer of sulphuric acid and also produces a large part of the amount it consumes. For the first ten months of this year production of acid in the fertilizer industry amounted to 1,219,487 tons expressed in terms of 50 deg. acid, as compared with 1,856,460 tons for the corresponding period of 1930. Purchases of acid from non-fertilizer manufacturers for the ten months reached a total of 233,529 tons, as against 358,998 tons for 1930 period.

SALES of plastic, cold-water paints and calcimines showed a falling off during October. Plastic paint sales were 674,332 lb., worth $75,886, as against 725,583 lb., worth $63,924, in September; calcimine sales of 3,376,616 lb., valued at $145,374, as against 3,691,186 lb., with a value of $161,743 the previous month, and cold-water paint sales in dry form of 909,315 lb., worth $65,275, against 1,193,325 lb., valued at $81,037. Sales of plastic paints for the first ten months of the year amounted to $835,772, against $1,123,900 last year; of calcimines, $1,317,669, against $1,553,736, and of cold-water paints in dry form, $820,104, as compared with $842,895 in 1930.

November tag sales for fertilizer as reported by the National Fertilizer Association were approximately 90 per cent of those for November, 1930. Tag sales for the four months, August-November, in the sixteen tag sales states were 76 per cent of those for the corresponding period of last year.

Statistics reported by the Department of Commerce put October paint, varnish, and lacquer sales at $20,764,464, as against $26,578,618 a year ago and $35,915,894 in 1929. Of these, $13,947,242 were classified, $8,490,645 being trade and $5,368,491 industrial sales, as against $17,986,075 classified, divided into $10,140,678 trade and $7,615,486 industrial, and $24,541,593 classified, $12,552,176 trade and $11,714,213 industrial, during the two years preceding. For the first ten months of the year the total paint, lacquer, and varnish sales equaled $248,486,466, as compared with $311,804,811 and $384,730,420 in 1930 and 1929. The greatest falling off has been in industrial sales, reflecting the lesser construction program during 1931.

FOREIGN trade in chemicals continues to follow the lessened rate of industrial activities both here and abroad. Outward shipments of chemicals and related products in October were valued at $7,599,874, compared with $10,129,029 for October, 1930. In the coal-tar group a decided falling off was reported in exports of coal-tar colors and dyes, the totals being 1,013,569 lb. in October, this year, and 2,480,621 lb. in October, 1930.

Under the industrial chemicals group, exports were valued at $1,394,364 in October and $1,806,416 for the corresponding period of last year. Acetone showed a marked gain for the comparative periods and shipments of aluminum sulphate amounted to 6,145,277 lb., compared with 3,866,548 lb. in October, last year. Calcium carbide and bleaching powder also moved in larger volume than in October, 1930.

In the soda group, bichromate and sulphate were the only ones to surpass last year's figures, but the decline in caustic soda shipments was not large and the 10-months total for that product still favors the present year.

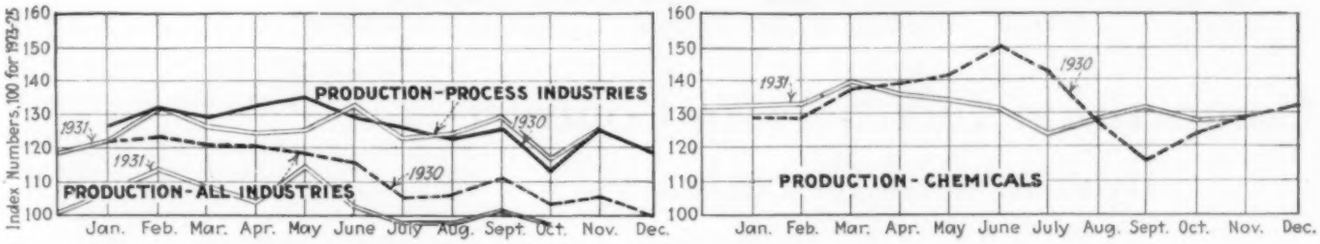
Foreign buying of carbon black was shown to have made headway, as October exports were 7,913,082 lb., as against 4,829,348 lb. in October, 1931.

Imports of chemicals and related products in October were valued at $6,591,642, which compares with $8,668,497 in October, last year. In the coal-tar group, imports of creosote oil fell off about 9 per cent from the October, 1930, total, but still reached the large figure of 4,621,206 lb.

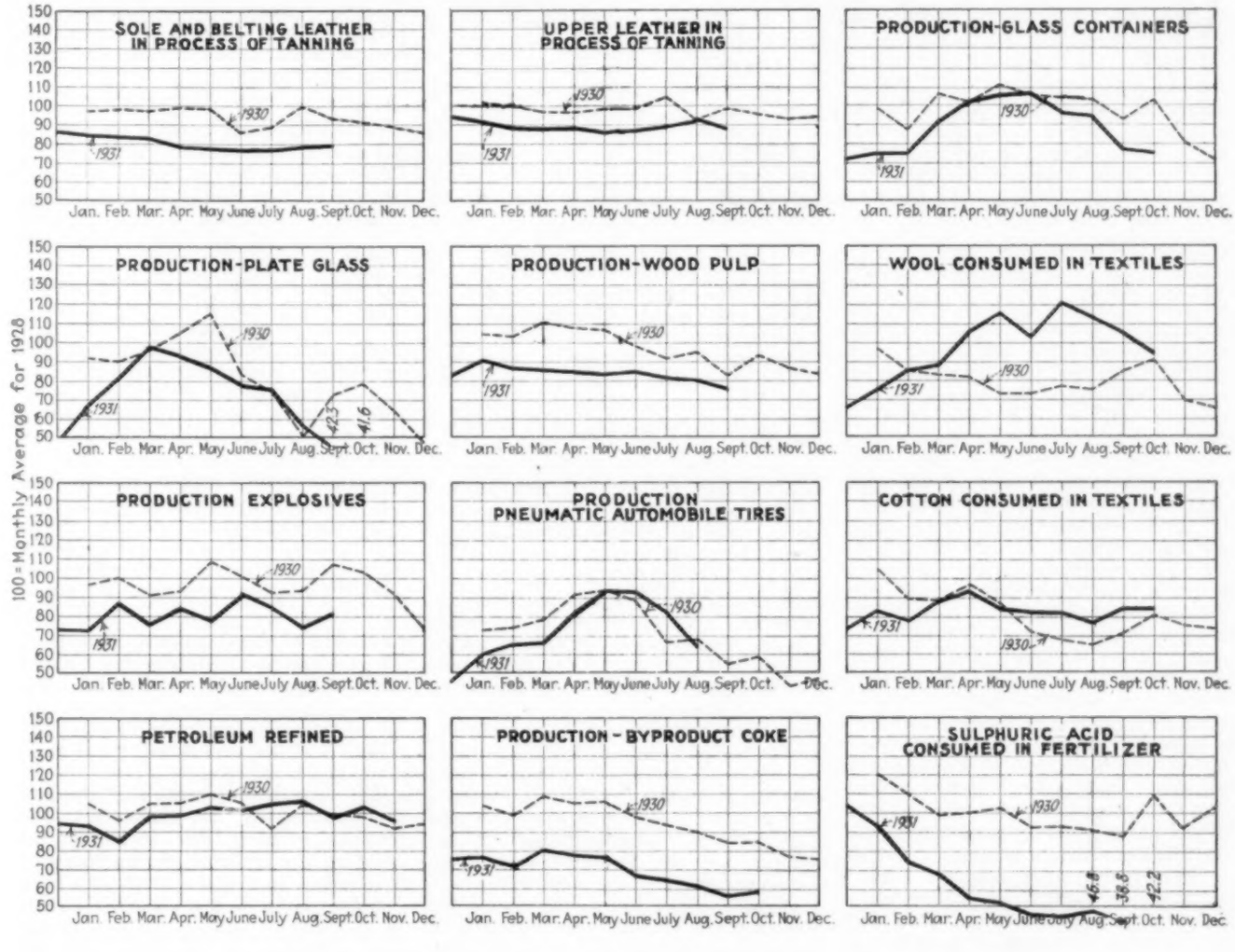
Incoming shipments of industrial chemicals in October were valued at $1,403,037, as against $2,143,296 in October, last year. Of the acids, formic was the only one to register a gain. Nitrate of ammonia was imported to a slightly larger extent, but a sharp drop was noted in the case of barium compounds. Crude glycerine and magnesium compounds showed improvement, as did potassium carbonate, potassium chlorate, and caustic potash.

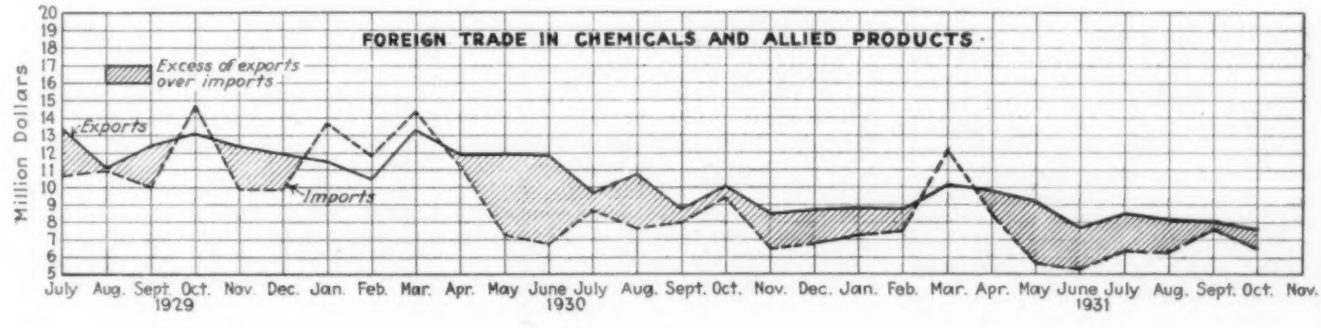
Featuring imports of fertilizer materials was a sharp increase in sulphate of ammonia; 18,616 tons in October, 1931, and 6,211 tons in October, 1930. Nitrate of soda also came in to a larger extent but imports of potash salts and other fertilizer materials registered declines.

# ACTIVITY IN PRODUCING AND CONSUMING INDUSTRIES




*Based on electrical power consumption, data supplied by Electrical World*





FOREIGN TRADE IN CHEMICALS AND ALLIED PRODUCTS
Million Dollars
Excess of exports over imports
Exports
Imports
July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec. Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov.
1929
1930
1931

# MARKET CONDITIONS AND PRICE TRENDS

## Competition Increases for Contract Business in Chemicals

### Selling Pressure Gives Price Advantage to Consuming Industries

WITH consuming industries covered on their raw material requirements for the present month, the market for chemicals has been of interest chiefly because of developments connected with contract placements for next year. While the volume of contract orders cannot be reduced to definite terms, it is safe to say that orders booked for 1932 delivery are considerably below those placed at this time last year for 1931 delivery.

In some cases, however, producers adopted an active policy and were more desirous than heretofore to place long-term orders on their books. Bichromates, especially the soda variety, came in for wider attention because leading sellers were competing keenly, and it is evident that enlarged production, as represented by a new producing company, has disturbed the even tenor which has marked sales of this product in recent years. Somewhat similar conditions were found in the market for butyl alcohol, where selling pressure was heightened by the addition of a new synthetic production.

Contracts for calcium chloride likewise were placed at prices below those quoted in the last few years. The lowering of prices coincided in time with a report that one of the large mineral oil companies had developed a source of supply for calcium chloride and was taking steps to dispose of its production for the coming year. In this connection it may be mentioned that a report from Canada states an evaporating plant for calcium chloride production may be built at Rivercourse, Alberta. This is based on the result of oil drilling operations in the Ribstone area. Two wells are said to make possible a daily production of 25 tons of calcium chloride.

FORWARD buying of alkalis made some progress during the month, but no new price developments were brought to light. Many consumers are holding back because they believe any change in the quoted prices would be in their favor. On the other hand, producers are not adopting a price-cutting policy and it seems certain that the low level of prices which distinguished contract trading a year ago will not be reached on 1932 business.

Anhydrous ammonia has been offered by some producers with quotations varying according to point of delivery. If this method becomes general it will be a departure from the custom followed in the last few years. For instance, 1931 contracts were written on a delivered basis with freight charges also allowed for return of empty cylinders. In view of the proposed increase in freight rates it is probable that a zoning system will determine the delivered price.

REPORTS regarding the alcohol industry indicate that producers are holding firm views about values. Persistent rumors have been in the market to the effect that the future price trend would be upward. One report says it is the trade belief that only moderate advances will be established for the coming year. The biggest interests, which cooperated in the recent production agreement with the government, desire only to effect stabilization at a level which will furnish a living profit, however low that level may be, and have no intention of taking advantage of consumers. High prices would inevitably lead to breaking of agreements and a return of the 1931 price demoralization.

The nitrogen situation remains in an unsettled position. Nitrate of soda not only has suffered from restrictions regarding shipments to different European countries but also has been depressed by internal conditions. Press reports have stated that the government commission considered a recommendation for dissolution of the Cosach combination. Later reports say the commission will recommend changes, one stipulation being that the Chilean government shall require a controlling interest in the combination.

In a hard drive for business abroad, our synthetic ammonia and nitrate companies are hammering State and Commerce Departments for intervention to break the cordon of embargos in Europe. They have not yet revealed whether they are motivated by purely business or political reasons. If they can demonstrate that foreign markets are closed to them, it would not be surprising if they should urge Congress to adopt the same policy. Deprived of a great free market, other countries might be forced into line on a rational program.

The report that Germany would permit entry of 50,000 tons of Chile nitrate brought a request that the State Department make protestations that this discriminates against the American synthetic product. Pondering over this, State Department attorneys concluded that they could not maintain such a contention when our own tariff, by applying different rates, makes a distinction between natural crude and synthetic camphor.

ADVICES from London state that a bill was introduced in the British Parliament on Nov. 13 calling for extension of the United Kingdom Dyestuffs Act throughout all of next year. The present act will function until the end of this year.

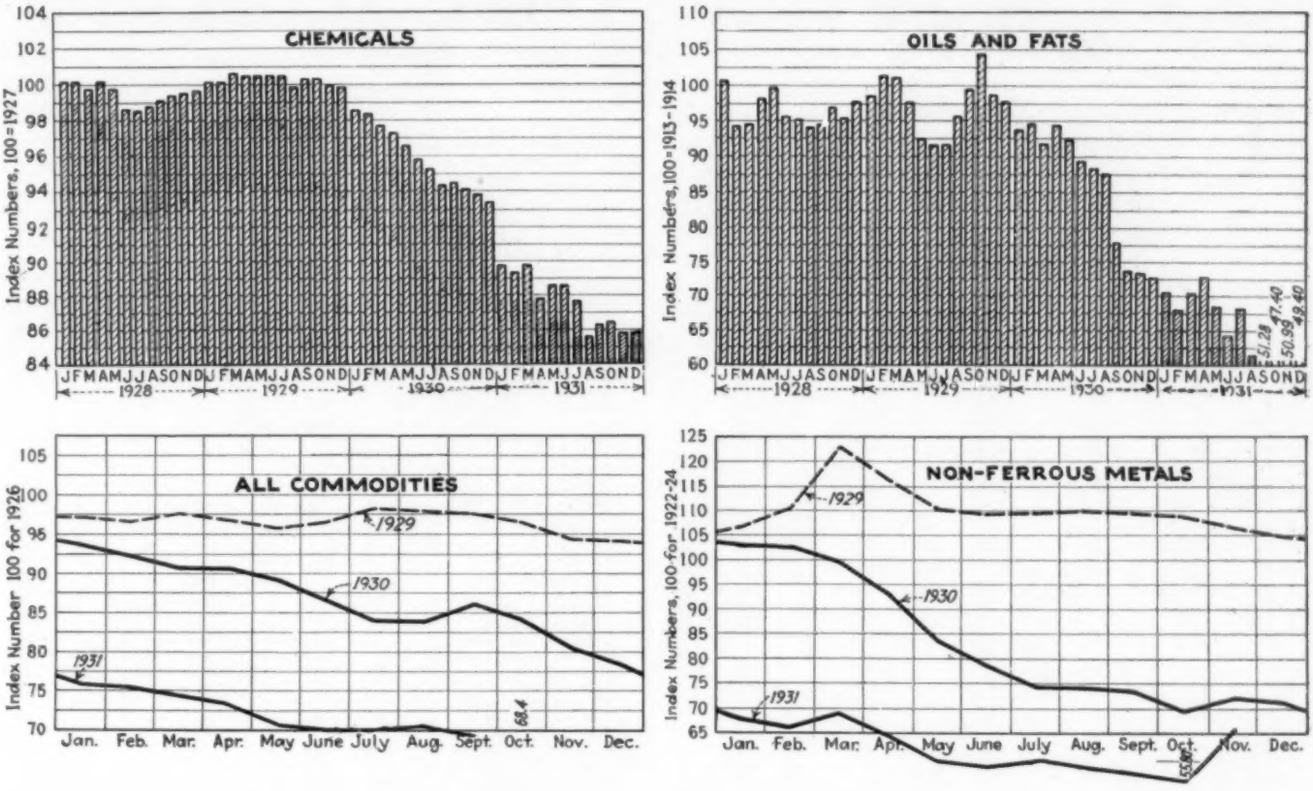
The act prohibits the importation, except under license issued by the Board of Trade, of all synthetic organic dyestuffs, colors, and coloring matters and all organic intermediate products used in the manufacture of any such dyestuffs, colors, and coloring matters. Under a revised ruling adopted in January, 1931, import licenses will be granted if British makers are not willing to supply dyestuffs at the foreign prices, provided these are not "dumping" prices, defined as prices below which foreign makers are selling the products in other countries.

TARIFF developments include a proclamation reducing the duty on crude feldspar from $1 to 50c. a ton. The lower duty will become effective Jan. 1. No change was made in the duty on ground feldspar, and it will stand at 30 per cent ad valorem.

The commission found that the cost of Canadian feldspar, exclusive of the cost of grinding but including the weighted average cost of transportation from mines to grinding mills and from grinding mills to the principal United States markets, exceeds the cost of domestic feldspar by $2.44 per ton and that after taking into consideration the difference in price between Canadian and domestic feldspar and making allowance for the possible effect upon costs of the depreciation in the Canadian dollar, the maximum reduction of 50 per cent in duty permitted by law is warranted.

A reduction of 25 per cent in the present rate of duty on window glass also was proclaimed and an application was received from the Argentine asking for a reduction in the duty on casein.

# CHEM. & MET. *Weighted Indexes of* PRICES




# Competitive Influences Affect Values of Chemicals

THE entrance of new producers into the market has been a disturbing factor on values of some chemicals. More than a month ago it was announced that a new plant in Ohio had entered upon the production of bichromate of soda. A decline of ½c. per pound immediately followed. In the last month this chemical has been under competitive influences and contracts are reported to have been written at private terms with buyers securing more favorable prices than was the case a year ago.

A short time ago, competition in butyl alcohol was enlivened by the presence of a new selling factor, and market prices for this product and for butyl acetate underwent a downward revision.

Still more recently, it was reported that a new source of supply for calcium chloride was available, and at the same time this chemical, which for a long time had been maintained at an unchanged price level, was sharply reduced in price.

The introduction of new producing companies, therefore, has been an important price factor in the market during the month. Selling pressure in a few other selections also has been reported, but, in general, values have held a steady course.

Producers of metal salts have varied quotations for some time according to the movements of the metal market. A month ago it was thought that metals were on the upgrade, but later developments belied this contention, and a new low of 6¼c. per lb. was reached by copper, while tin sold below any price in effect since 1899. As a result copper sulphate reached an all-time low price of 3.10c. per 100 lb. and tin salts were lowered accordingly. At present, members of the metal trade are optimistic, expecting an announcement which will strengthen the copper market and anticipating a wider buying movement to steady the market in general.

Copperas presents one of the strong spots in the market. Restricted production has held supplies at low levels and spot quotations are little better than nominal.

Vegetable oils are weak in foreign primary markets and, with ample supplies in this country and animal fats at low levels, the outlook for the immediate future would not indicate any important price changes. While the flaxseed crop in this country was materially curtailed this year, Argentine supplies are large and prices for linseed oil are likely to be influenced largely by Argentine seed fluctuations.

### Chem. & Met. Weighted Index of Chemical Prices

Base = 100 for 1927

| | |
|---|---|
| **This month** | **85.94** |
| Last month | 85.98 |
| December, 1930 | 93.17 |
| December, 1929 | 99.73 |

**While competition for contract business, in some cases, has weakened values, the chemical list as a whole did not vary much during the period. Spirits of turpentine and calcium chloride were lowered in price. Alcohol was firm with price advances probable.**

### Chem. & Met. Weighted Index of Prices for Oil and Fats

Base = 100 for 1927

| | |
|---|---|
| **This month** | **49.40** |
| Last month | 50.99 |
| December, 1930 | 72.69 |
| December, 1929 | 97.52 |

**The majority of vegetable oils revealed a declining price during the last month. Linseed oil not only declined in price but was subject to shading of the quoted figures. Tallow and animal fats showed but little net change for the period.**

# CURRENT PRICES *in the* NEW YORK MARKET

THE following prices refer to round lots in the New York market. Where it is the trade custom to sell f.o.b. works, quotations are given on that basis and are so designated. Prices are corrected to Dec. 15.

## Industrial Chemicals

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Acetone, drums, lb. | $0.10 -$0.11 | $0.10 -$0.11 | $0.11 -$0.12 |
| Acid, acetic, 28%, bbl., cwt. | 2.50 - 2.75 | 2.50 - 2.75 | 2.60 - 2.85 |
| Glacial 99%, tanks | 8.10 - | 8.10 - | 8.98 - |
| drs. | 8.35 - 8.60 | 8.35 - 8.60 | 9.23 - 9.48 |
| U. S. P. reagent, c'bys. | 8.85 - 9.10 | 8.85 - 9.10 | 9.73 - 9.98 |
| Boric, bbl., lb. | .06½- .07 | .06½- .07 | .06½- .07 |
| Citric, kegs, lb. | .35 - .36 | .35 - .36 | .43½- .45 |
| Formic, bbl., lb. | .10 - .11 | .10 - .11 | .10 - .11 |
| Gallic, tech., bbl., lb. | .50 - .55 | .50 - .55 | .50 - .55 |
| Hydrofluoric 30% carb., lb. | .06 - .07 | .06 - .07 | .06 - .07 |
| Latic, 44%, tech., light, bbl., lb. | .11½- .12 | .11½- .12 | .11½- .12 |
| 22%, tech., light, bbl., lb. | .05½- .06 | .05½- .06 | .05½- .06 |
| Muriatic 18° tanks, cwt. | 1.00 - 1.10 | 1.00 - 1.10 | 1.00 - 1.10 |
| Nitric, 36°, carboys, lb. | .05 - .05¼ | .05 - .05¼ | .05 - .05¼ |
| Oleum, tanks, wks., ton | 18.50 -20.00 | 18.50 - | 18.50 -20.00 |
| Oxalic, crystals, bbl., lb. | .11 - .11½ | .11 - .11½ | .11 - .12 |
| Phosphoric, tech., c'bys., lb. | .08½- .09 | .08½- .09 | .08½- .09 |
| Sulphuric, 60°, tanks, ton | 11.00 -11.50 | 11.00 -11.50 | 11.00 -11.50 |
| Tannic, tech., bbl., lb. | .23 - .35 | .23- .35 | .35 - .40 |
| Tartaric, powd., bbl., lb. | .26½- .27½ | .26½- .27½ | .31 - .33 |
| Tungstic, bbl., lb. | 1.40 - 1.50 | 1.40 - 1.50 | 1.40 - 1.50 |
| Alcohol, ethyl, 190 p'f., bbl., gal. | 2.33 - | 2.33 - | 2.63 - 2.71 |
| Alcohol, Butyl, tanks, lb. | 14.3 - | .14½- | .16½- .17 |
| Alcohol, Amyl | - | - | - |
| From Pentane, tanks, lb. | .203- | .203- | .236- |
| Denatured, 188 proof | | | |
| No. 1 special dr., gal. | .28 - | .28 - | .40 - |
| No. 5, 188 proof, dr., gal. | .28 - | .28 - | .40 - |
| Alum, ammonia, lump, bbl., lb. | .03½- .04 | .03½- .04 | .03½- .04 |
| Chrome, bbl., lb. | .04½- .05 | .04½- .05 | .05 - .05½ |
| Potash, lump, bbl., lb. | .03½- .04 | .03½- .04 | .03 - .03½ |
| Aluminum sulphate, com., bags, cwt. | 1.25 - 1.40 | 1.25 - 1.40 | 1.40 - 1.45 |
| Iron free, bg., cwt. | 1.90 - 2.00 | 1.90 - 2.00 | 1.90 - 2.00 |
| Aqua ammonia, 26°, drums lb. | .02½- .03 | .02½- .03 | .03 - .04 |
| tanks, lb. | .02½- .02¾ | .02½- .02¾ | .02½- .02¾ |
| Ammonia, anhydrous, cyl., lb. | .15½- .15¾ | .15½- .15¾ | .15½- |
| tanks, lb. | .05½- | .05½- | .05½- |
| Ammonium carbonate, powd. tech., casks, lb. | .10½- .11 | .10½- .11 | .10½- .11 |
| Sulphate, wks., cwt. | 1.10 - | 1.10 - | 1.75 - |
| Amylacetate tech., tanks, lb., gal. | .16½- | .16½- | .222- |
| Antimony Oxide, bbl., lb. | .08 - .09 | .08 - .09 | .08½- .10 |
| Arsenic, white, powd., bbl., lb. | .04 - .04½ | .04 - .04½ | .04 - .04½ |
| Red, powd., kegs, lb. | .09 - .10 | .09 - .10 | .09 - .10 |
| Barium carbonate, bbl., ton | 56.50 -58.00 | 56.50 -58.00 | 58.00 -60.00 |
| Chloride, bbl., ton | 63.00 -65.00 | 63.00 -65.00 | 63.00 -65.00 |
| Nitrate, cask, lb. | .07 - .07½ | .07 - .07½ | .07 - .07½ |
| Blanc fixe, dry, bbl., lb. | .03½- .04 | .03½- .04 | .03½- .04 |
| Bleaching powder, f.o.b., wks., drums, cwt. | 2.00 - 2.10 | 2.00 - 2.10 | 2.00 - 2.10 |
| Borax, grain, bags, ton | 50.00 -57.00 | 50.00 -57.00 | 50.00 -57.00 |
| Bromine, cs., lb. | .36 - .38 | .36 - .38 | .45 - .47 |
| Calcium acetate, bags | 2.00 - | 2.00 - | 2.00 - |
| Arsenate, dr., lb. | .06 - .07 | .06 - .07 | .07 - .08 |
| Carbide drums, lb. | .05 - .06 | .05 - .06 | .05 - .06 |
| Chloride, fused, dr., wks., ton. | 18.00 - | 20.00 - | 20.00 - |
| flake, dr., wks., ton. | 21.00 - | 22.75 - | 22.75 - |
| Phosphate, bbl., lb. | .08 - .08¼ | .08 - .08¼ | .08 - .08¼ |
| Carbon bisulphide, drums, lb. | .05 - .06 | .05 - .06 | .05 - .06 |
| Tetrachloride drums, lb. | .06½- .07 | .06½- .07 | .06½- .07 |
| Chlorine, liquid, tanks, wks., lb. | .01½- | .01½- | .02 - |
| Cylinders | .04 - .06 | .04 - .06 | .04 - .06 |
| Cobalt oxide, cans, lb. | 1.35 - 1.45 | 1.35 - 1.45 | 2.10 - 2.25 |
| Copperas, bgs., f.o.b. wks., ton. | 13.00 -14.00 | 13.00 -14.00 | 13.00 -14.00 |
| Copper carbonate, bbl., lb. | .07 - .16 | .08½- .18 | .08½- .18 |
| Cyanide, tech., bbl., lb. | .39 - .44 | .39 - .44 | .41 - .46 |
| Sulphate, bbl., cwt. | 3.10 - 3.25 | 3.40 - 3.50 | 4.25 - 4.50 |
| Cream of tartar, bbl., lb. | .20½- .22 | .21½- .22 | .24½- .26 |
| Diethylene glycol, dr., lb. | .14 - .16 | .14 - .16 | .14 - .16 |
| Epsom salt, dom., tech., bbl., cwt. | 1.70 - 2.00 | 1.70 - 2.00 | 1.75 - 2.00 |
| Imp., tech., bags, cwt. | 1.15 - 1.25 | 1.15 - 1.25 | 1.15 - 1.25 |
| Ethyl acetate, drums, lb. | .06½- | .06½- | .094- |
| Formaldehyde, 40%, bbl., lb. | .06 - .07 | .06 - .07 | .06 - .07 |
| Furfural, dr., contract, lb. | .10 - .15 | .10 - .12 | .10 - .12 |
| Fusel oil, crude, drums, gal. | 1.10 - 1.20 | 1.10 - 1.20 | 1.30 - 1.40 |
| Refined, dr., gal. | 1.80 - 1.90 | 1.80 - 1.90 | 1.90 - 2.00 |
| Glaubers salt, bags, cwt. | 1.00 - 1.10 | 1.00 - 1.10 | 1.00 - 1.10 |
| Glycerine, c.p., drums, extra, lb. | .11½- .12 | .11½- .12 | .13 - .14 |
| Lead: | | | |
| White, basic carbonate, dry casks, lb. | .07½- | .07½- | .07½- |
| White, basic sulphate, sck., lb. | .07 - | .07 - | .07 - |
| Red, dry, sck., lb. | .07½- | .07½- | .08½- |
| Lead acetate, white crys., bbl., lb. | .11 - .12 | .11 - .12 | .11½- .12 |
| Lead arsenate, powd., bbl., lb. | .10 - .14 | .10 - .14 | .13 - .14 |
| Lime, chem., bulk, ton | 8.50 - | 8.50 - | 8.50 - |
| Litharge, pwd., csk, lb. | .06 - | .06½- | .07½- |
| Lithophone, bags, lb. | .04½- .05 | .04½- .05 | .05½- .06 |
| Magnesium carb., tech., bags, lb. | .06 - .06½ | .06 - .06½ | .06 - .06½ |
| Methanol, 95%, tanks, gal. | .33 - | .33 - | .38 - |
| 97%, tanks, gal. | .34 - | .34 - | .39 - |
| Synthetic, tanks, gal. | .35½- | .37½- | .35½- |
| Nickel salt, double, bbl., lb. | .10½- .11 | .10½- .11 | .13 - .13½ |
| Single, bbl., lb. | .10½- .11 | .10½- .11 | .13 - .13½ |
| Orange mineral, csk., lb. | .09½- | .09½- | .10½- |
| Phosphorus, red, cases, lb. | .42 - .44 | .42 - .44 | .42 - .44 |
| Yellow, cases, lb. | .31 - .32 | .31 - .32 | .31 - .32 |
| Potassium bichromate, casks, lb. | .08½- .09 | .08½- .09 | .09 - .09½ |
| Carbonate, 80-85%, calc., csk., lb | .05 - .05½ | .05 - .05½ | .05½- .06 |
| Chlorate, powd., lb. | .08 - .08½ | .08 - .08½ | .08½- .09 |
| Cyanide, cs., lb. | .55 - .57 | .55 - .57 | .55 - .57 |
| First sorts, csk., lb. | .08½- .09 | .08½- .09 | .08½- .09 |
| Hydroxide (c'stic potash) dr., lb. | .06½- .06¾ | .06½- .06¾ | .06½- .06¾ |
| Muriate, 80% bgs., ton | 37.15 - | 37.15 - | 37.15 - |
| Nitrate, bbl., lb. | .05½- .06 | .05½- .06 | .06 - .07½ |
| Permanganate, drums, lb. | .16 - .16½ | .16 - .16½ | .16 - .16½ |
| Prussiate, yellow, casks, lb. | .18½- .19½ | .18½- .19 | .18½- .19 |
| Sal ammoniac, white, casks, lb. | .04½- .05 | .04½- .05 | .047- .05 |
| Salsoda, bbl., cwt. | .90 - .95 | .90 - .95 | .90 - .95 |
| Salt cake, bulk, ton | 16.00 -18.00 | 16.00 -18.00 | 15.00 -18.00 |
| Soda ash, light, 58%, bags, contract, cwt. | 1.15 - | 1.15 - | 1.32 - |
| Dense, bags, cwt. | 1.17½- | 1.17½- | 1.35 - |
| Soda, caustic, 76%, solid, drums, contract, cwt. | 2.50 - 2.75 | 2.50 - 2.75 | 2.90 - 3.00 |
| Acetate, works, bbl., lb. | .05 - .06 | .05 - .06 | .04½- .05 |
| Bicarbonate, bbl., cwt. | 1.85 - 2.00 | 1.85 - 2.00 | 2.00 - 2.25 |
| Bichromate, casks, lb. | .06 - .07 | .06½- .07 | .07 - .07½ |
| Bisulphate, bulk, ton | 14.00 -16.00 | 14.00 -16.00 | 14.00 -16.00 |
| Bisulphite, bbl., lb. | .03½- .04 | .03½- .04 | .03½- .04 |
| Chlorate, kegs, lb. | .05½- .07½ | .05½- .07½ | .05½- .07½ |
| Chloride, tech., ton | 12.00 -14.75 | 12.00 -14.75 | 12.00 -14.00 |
| Cyanide, cases, dom., lb. | .16½- .17 | .16½- .17 | .17 - .18 |
| Fluoride, bbl., lb. | .07½- .08 | .07½- .08 | .08 - .09 |
| Hyposulphite, bbl., lb. | 2.40 - 2.50 | 2.40 - 2.50 | 2.40 - 2.50 |
| Nitrate, bags, cwt. | 1.77 - | 1.77 - | 2.02 - |
| Nitrite, casks, lb | .07½- .08 | .07½- .08 | .07½- .08 |
| Phosphate, dibasic, bbl., lb. | .0265 - .03 | .0265 - .03 | .03 - .03½ |
| Prussiate, yel. drums, lb. | .11½- .12 | .11½- .12 | .11½- .12 |
| Silicate (30°, drums), cwt. | .60 - .70 | .60 - .70 | .60 - .70 |
| Sulphide, fused, 60-62%, dr., lb. | .02½- .03½ | .02½- .03 | .02½- .03 |
| Sulphite, cyrs., bbl., lb. | .03 - .03½ | .03 - .03½ | .03 - .03½ |
| Sulphur, crude at mine, bulk, ton | 18.00 - | 18.00 - | 18.00 - |
| Chloride, dr., lb. | .05 - .06 | .05 - .06 | .05 - .06 |
| Dioxide, cyl., lb. | .06½- .07 | .06½- .07 | .06½- .07 |
| Flour, bag, cwt. | 1.55 - 3.00 | 1.55 - 3.00 | 1.55 - 3.00 |
| Tin bichloride, bbl., lb. | nom.- | nom.- | nom.- |
| Oxide, bbl., lb. | .25 - | .26 - | .30 - |
| Crystals, bbl., lb. | .22½- | .24½- | .25 - |
| Zinc chloride, gran., bbl., lb. | .06½- .06¾ | .06½- .06¾ | .06½- .06¾ |
| Carbonate, bbl., lb. | .10½- .11 | .10½- .11 | .10½- .11 |
| Cyanide, dr., lb. | .41 - .42 | .41 - .42 | .41 - .42 |
| Dust, bbl., lb. | .05½- .06 | .05½- .06 | .07½- .08 |
| Zinc oxide, lead free, bag, lb. | .06½- | .06½- | .06½- |
| 5% lead sulphate, bags, lb. | .06½- | .06½- | .06½- |
| Sulphate, bbl., cwt. | 3.00 - 3.25 | 3.00 - 3.25 | 3.00 - 3.25 |

## Oils and Fats

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Castor oil, No. 3, bbl., lb. | $0.09½-$0.10½ | $0.10½-$0.11 | $0.11½-$0.12½ |
| Chinawood oil, bbl., lb. | .07 - | .08½- | .07 - |
| Coconut oil, Ceylon, tanks, N. Y. lb. | .03½- | .03½- | .05½- |
| Corn oil crude, tanks, (f.o.b. mill), lb. | .03½- | .04½- | .07½- |
| Cottonseed oil, crude (f.o.b. mill), tanks, lb. | .03½- | .03½- | .06½- |
| Linseed oil, raw, car lots, bbl., lb. | .072- | .075- | .094- |
| Palm, Lagos, casks, lb. | .04 - | .04½- | .06½- |
| Niger, casks, lb. | .03½- | .03½- | .05½- |
| Palm Kernel, bbl., lb. | .05½- | .05 - | .06½- |
| Peanut oil, crude, tanks (mill), lb. | .04 - | .05½- | .06½- |
| Rapeseed oil, refined, bbl., gal. | .42 - .43 | .43 - .44 | .54 - .56 |
| Soya bean, tank (f.o.b. Coast), lb | nom.- | nom.- | .08½- |
| Sulphur (olive foots), bbl., lb. | .04½- | .04½- | .06½- |
| Cod, Newfoundland, bbl., gal. | .30 - .32 | .26 - .28 | .50 - .52 |
| Menhaden, light pressed, bbl., gal. | .33 - .34 | .33 - .34 | .40 - .42 |
| Crude, tanks (f.o.b. factory), gal. | .17½- | .20 - | .20 - |
| Whale, crude, tanks, gal. | nom.- | nom.- | - .78 |
| Grease, yellow, loose, lb. | .02½- | .02½- | .04½- |
| Oleo stearine, lb. | .06½- | .06½- | .08½- |
| Red oil, distilled, d.p. bbl., lb. | .07½- | .07½- | .08½- |
| Tallow, extra, loose, lb. | .03½- | .03½- | .04½- |

## Coal-Tar Products

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Alpha-naphthol, crude, bbl., lb. | $0.60 -$0.65 | $0.60 -$0.65 | $0.60 -$0.62 |
| Refined, bbl., lb. | .80 - .85 | .80 - .85 | .80 - .85 |
| Alpha-naphthylamine, bbl., lb. | .32 - .34 | .32 - .34 | .32 - .34 |
| Aniline oil, drums, extra, lb. | .14½- .15 | .14½- .15 | .15 - .16 |
| Aniline salts, bbl., lb. | .24 - .25 | .24 - .25 | .24 - .52 |

## Coal-Tar Products (Continued)

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Benzaldehyde, U.S.P., dr., lb. | $1.10 -$1.25 | $1.10 -$1.25 | $1.15 -$1.25 |
| Benzidine base, bbl., lb. | .65 - .67 | .65 - .67 | .65 - .67 |
| Benzoic acid, U.S.P., kgs, lb. | .48 - .52 | .48 - .52 | .57 - .60 |
| Benzyl chloride, tech., dr., lb. | .30 - .35 | .30 - .35 | .30 - .35 |
| Benzol, 90%, tanks, works, gal. | .20 - .21 | .20 - .21 | .21 - .22 |
| Beta-naphthol, tech., drums, lb. | .22 - .24 | .22 - .24 | .22 - .24 |
| Cresol, U. S. P., dr., lb. | .12½- .14 | .12½- .14 | .14 - .17 |
| Cresylic acid, 97%, dr., wks., gal. | .54 - .58 | .54 - .58 | .58 - .61 |
| Diethylaniline, dr., lb. | .55 - .58 | .55 - .58 | .55 - .58 |
| Dinitrophenol, bbl., lb. | .29 - .30 | .29 - .30 | .29 - .30 |
| Dinitrotoluen, bbl. lb. | .16 - .17 | .16 - .17 | .16 - .17 |
| Dip oil 25% dr., gal. | .23 - .25 | .26 - .28 | .26 - .28 |
| Diphenylamine, bbl., lb. | .38 - .40 | .38 - .40 | .38 - .40 |
| H-acid, bbl., lb. | .65 - .70 | .65 - .70 | .68 - .70 |
| Naphthalene, flake, bbl., lb. | .03½- .04¼ | .03½- .04¼ | .03½- .04½ |
| Nitrobenzene, dr., lb. | .08½- .09 | .08½- .09 | .08½- .10 |
| Para-nitraniline, bbl., lb. | .51 - .55 | .51 - .55 | .51 - .55 |
| Para-nitrotoluine, bbl., lb. | .29 - .30 | .29 - .31 | .29 - .31 |
| Phenol, U.S.P., drums, lb. | .14½- .15 | .14¼- .15 | .14½- .15 |
| Picric acid, bbl., lb. | .30 - .40 | .30 - .40 | .30 - .40 |
| Pyridine, dr., lb. | 1.50 - 1.75 | 1.50 - 1.80 | 1.50 - 1.80 |
| R-salt, bbl., lb. | .40 - .44 | .40 - .44 | .40 - .44 |
| Resorcinal, tech., kegs, lb. | .70 - .80 | .70 - .80 | 1.15 - 1.25 |
| Salicylic acid, tech., bbl., lb. | .33 - .35 | .33 - .35 | .33 - .35 |
| Solvent naphtha, w.w., tanks, gal. | .26 - | .26 - | .25 - .30 |
| Tolidine, bbl., lb. | .86 - .88 | .86 - .88 | .88 - .90 |
| Toluene, tanks, works, gal. | .30 - | .30 - | .30 - |
| Xylene, com., tanks, gal. | .26 - | .26 - | .25 - .28 |

## Miscellaneous

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Barytes, grd., white, bbl., ton. | $23.00-$25.00 | $23.00-$25.00 | $23.00-$25.00 |
| Casein, tech., bbl., lb. | .07½- .14 | .07½- .14 | .10½- .12 |
| China clay, dom., f.o.b. mine, ton | 8.00 -20.00 | 8.00 -20.00 | 8.00 -20.00 |
| Dry colors: | | | |
| Carbon gas, black (wks.), lb. | .03 - .20 | .03 - .20 | .04 - .22 |
| Prussian blue, bbl., lb. | .35 - .36 | .35 - .36 | .35 - .36 |
| Ultramine blue, bbl., lb. | .06 - .32 | .06 - .32 | .06 - .32 |
| Chrome green, bbl., lb. | .27 - .28 | .27 - .28 | .27 - .30 |
| Carmine red, tins, lb. | 5.00 - 5.40 | 5.00 - 5.40 | 6.00 - 6.50 |
| Para toner, lb. | .75 - .80 | .75 - .80 | .77 - .80 |
| Vermilion, English, bbl., lb. | 1.55 - 1.60 | 1.55 - 1.60 | 1.75 - 1.90 |
| Chrome yellow, C. P., bbl., lb. | .16½- .17 | .16½- .17 | .16½- .17 |
| Feldspar, No. 1 (f.o.b. N.C.), ton | 6.50 - 7.50 | 6.50 - 7.50 | 6.50 - 7.50 |
| Graphite, Ceylon, lump, bbl., lb. | .07 - .08½ | .07 - .08½ | .07 - .08½ |
| Gum copal Congo, bags, lb. | .06 - .08 | .06 - .08 | .07 - .09 |
| Manila, bags, lb. | .16 - .17 | .16 - .17 | .16 - .17 |
| Damar, Batavia, cases, lb. | .16 - .16½ | .16 - .19 | .16 - .16½ |
| Kauri No. 1 cases, lb. | .45 - .48 | .45 - .48 | .48 - .53 |
| Kieselguhr (f.o.b. N.Y.), ton. | 50.00 -55.00 | 50.00 -55.00 | 50.00 -55.00 |
| Magnesite, calc, ton. | 40.00 - | 40.00 - | 40.00 - |
| Pumice stone, lump, bbl., lb. | .05 - .07 | .05 - .08 | .05 - .07 |
| Imported, casks, lb. | .03 - .40 | .03 - .40 | .03 - .35 |
| Rosin, H., bbl. | 4.00 - | 4.35 - | 5.55 - |
| Turpentine, gal. | .39 - | .41½- | .41 - |
| Shellac, orange, fine, bags, lb. | .38 - .40 | .38 - .40 | .42 - .43 |
| Bleached, bonedry, bags, lb. | .28 - .30 | .28 - .30 | .28 - .30 |
| T. N. bags, lb. | .16 - .17 | .16 - .17 | .19 - .21 |
| Soapstone (f.o.b. Vt.), bags, ton | 10.00 -12.00 | 10.00 -12.00 | 10.00 -12.00 |
| Talc, 200 mesh (f.o.b. Vt.), ton. | 8.00 - 8.50 | 8.00 - 8.50 | 9.50 - |
| 300 mesh (f.o.b. Ga.), ton. | 7.50 -10.00 | 7.50 -10.00 | 7.50 -11.00 |
| 225 mesh (f.o.b. N. Y.), ton. | 13.75 - | 13.75 - | 13.75 - |

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Wax, Bayberry, bbl., lb. | $0.16 -$0.20 | $0.16 -$0.20 | $0.22 -$0.24 |
| Beeswax, ref., light, lb. | .25 - .27 | .25 - .27 | .33 - .35 |
| Candelilla, bags, lb. | .14½- | .13½- .14 | .16 - .18 |
| Carnuba, No. 1, bags, lb. | .32 - .33 | .32 - .33 | .26 - .27 |
| Paraffine, crude 105-110 m.p., lb. | .03½- .03½ | .03½- .04¼ | .04 - .04½ |

## Ferro-Alloys

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Ferrotitanium, 15-18%, ton. | $200.00- | $200.00- | $200.00- |
| Ferromanganese, 78-82%, ton. | 80.00-85.00 | 80.00-85.00 | 94.00-99.00 |
| Ferrochrome, 65-70% | 11- | 11- | - |
| Spiegeleisen, 19-21% ton. | 30.00- | 30.00- | 33.00- |
| Ferrosilicon, 14-17%, ton. | 31.00- | 31.00- | 39.00- |
| Ferrotungsten, 70-80%, lb. | 1.00- 1.10 | 1.00- 1.10 | 1.10- |
| Ferrovanadium, 30-40%, lb. | 3.15- 3.50 | 3.15- 3.50 | 3.15- 3.50 |

## Non-Ferrous Metals

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Copper, electrolytic, lb. | $0.06½- | $0.07 - | $0.10½- |
| Aluminum, 96-99%, lb. | .23- | .23- | .23- |
| Antimony, Chin. and Jap., lb. | .06½- | .065- | .0705- |
| Nickel, 99%, lb. | .35 - | .35 - | .35 - |
| Monel metal blocks, lb. | .28 - | .28 - | .28 - |
| Tin, 5-ton lots, Straits, lb. | .20½- | .23 - | .251- |
| Lead, New York, spot, lb. | .0385- | .0405- | .051- |
| Zinc, New York, spot, lb. | .035- | .036- | .045- |
| Silver, commercial, oz. | .29½- | .35½- | .33½- |
| Cadmium, lb. | .55 - | .55 - | .70 - |
| Bismuth, ton lots, lb. | 1.50 - | 1.50 - | 1.00 - |
| Cobalt, lb. | 2.50 - | 2.50 - | 2.50 - |
| Magnesium, ingots, 99%, lb. | .30 - | .30 - | .48 - 1.00 |
| Platinum, ref., oz. | 40.00 - | 40.00 - | 36.00- |
| Palladium, ref., oz. | 19.00 - 21.00 | 19.00 - 21.00 | 22.00- 23.00 |
| Mercury, flask, 75 lb. | 67.00 - 69.00 | 70.00 - 72.00 | 105.00-107.00 |
| Tungsten powder, lb. | 1.45 - | 1.45 - | 1.55- 1.60 |

## Ores and Semi-finished Products

| | Current Price | Last Month | Last Year |
|---|---|---|---|
| Bauxite, crushed, wks., ton. | $6.50 -$8.25 | $6.50 -$8.25 | $6.50 -$8.25 |
| Chrome ore, c. f , post, ton. | 17.00 -20.00 | 17.00 -20.00 | 19.50 -24.00 |
| Coke, fdry., f.o b. ovens, t | 2.75 - 2.85 | 2.75 - 3.85 | 2.75 - 2.85 |
| Fluorspar, gravel, f.o.b. Il ., ton. | 17.25 -20.00 | 17.25 -20.00 | 17.25 -20.00 |
| Manganese ore, 50% Mn., c.i.f. Atlantic Ports, unit | .25 - .26 | .24 - .25 | .25 - .26 |
| Molybdenite, 85% $MoS_2$ per lb. $MoS_2$, N. Y., lb. | .45 - | .45 - | .33 - .35 |
| Monazite, 6% of $ThO_2$, ton., | 60.00 - | 60.00 - | 60.00- |
| Pyrites, Span. fines, c.i.f., unit. | .13 - | .13 - | .13 - |
| Rutile, 94-96% $TiO_2$, lb. | .10 - .11 | .10 - .11 | .10 - .11 |
| Tungsten, scheelite, 60% $WO_3$ and over, unit | 10.50 -12.00 | 9.50 -12.00 | 10.50 -12.00 |

# CURRENT INDUSTRIAL DEVELOPMENTS

### *New Construction and Machinery Requirements*

**Plant**—Illinois Carton Co., 2601 North Crawford St., Chicago, Ill., awarded contract for construction of a 1 story, 130 x 200 ft. plant at Clark and Elkhart Sts., Elkhart, Ind., to George Kistner & Son, 914 South Main St., Elkhart. Estimated cost $40,000.

**Celanese Plant**—Celanese Corp. of America, Cumberland, Md., awarded contract for a 1 story, 66 x 170 ft. addition to plant to Wright Richardson & Co., Cumberland. Estimated cost $80,000.

**Cement Plant Additions**—Marquette Cement Co., La Salle, Ill. and Cape Girardeau, Mo., plans additions and alterations to cement plants at La Salle and Cape Girardeau. Estimated cost to exceed $40,000 each. Maturity indefinite.

**Chemical Plant**—Continental Chemical Co., c/o P. J. McIntosh, Gen. Mgr., Burt Bldg., Dallas, Tex., will award contract at once for construction of a group of buildings for chemical plant to include evaporating building, pumping equipment, etc., at Tahoka. A. G. Alt, 301-D Thomas Bldg., Dallas, is engineer. A. G. Shuttler, Chicago, Ill., is associate engineer.

**Chemical Plant Addition**—Charles Pfizer & Co., 81 Maiden Lane, New York, N. Y. (manufacturing chemists) plans a 1 story addition to plant to include tank pits, fuel oil equipment, etc., at Gerry St. and Marcy Ave., Brooklyn. Estimated cost $40,000. Work will be done by day labor and separate contracts.

**Gas Plant**—City of Borger, Tex., awarded contract for construction of a natural gas plant including 40,000 ft. gas mains, booster plant, etc., to Joseph A. Greenspon & Sons, 3130 North Hall St., St. Louis, Mo. $125,000.

**Gas Plant** — City of Newton, Kan., voted $300,000 bonds for construction of a gas plant and distribution system. Adella Martin is city clerk.

**Gas Plant**—City of Wichita Falls, Tex., voted $925,000 bonds for construction of a natural gas system to include plant, distribution mains, etc.

**Gas Plant**—Keystone Gas Co. Inc., Millport, N. Y., plans construction of a gas plant in Chemung county.

**Gas Plant** — Lowville Gas Co., Lowville, N. Y., plans construction of a gas plant. Estimated cost to exceed $50,000. Work will be done by day labor and separate contracts under the supervision of Johnson, Church & Co., 149 Broadway, New York, Engrs.

**Gas Plant**—New York Central Electric Co., 61 Broadway, New York, N. Y., has been granted permit by Public Service Commission to construct gas plant and distribution system at Sparta, Livingston county.

**Gas Plant**—Warwick Gas Co., West Warwick, R. I., plans construction of a gas plant. Estimated cost $40,000. Johnson, Church & Co., 149 Broadway, New York, N. Y., are architects. Maturity summer 1932 or later.

**Gas Plant Additions**—Kings County Lighting Co., 6740 Fourth Ave., Brooklyn, N. Y., plans additions and extensions to gas plant at New Utrecht Ave. and 62nd St. Estimated cost to exceed $40,000.

**Gas and Coke Plant**—Cities of Fort William and Port Arthur, Ont., voted bylaw permitting Hamilton-By-product Coke Ovens Ltd., 4 Hughson St. S., Hamilton, to construct a gas and coke plant including distribution mains, etc. Estimated cost $1,000,000.

**Kiln, etc.**—Zanesville Stoneware Co., Zanesville, O., plans to expand and install a new Harrop tunnel kiln, also erection of annex to house equipment and will make other extensive improvements to plant. Estimated total cost $75,000. Private plans.

**Laboratory** — William Ginsberg, c/o Ex-Lax Inc., 331 Atlantic Ave., Brooklyn, N. Y., is receiving bids for a 6 story, 100 x 100 ft. laboratory building at Atlantic Ave. and Bond St. Estimated cost $150,000. V. Mayper, 110 West 40th St., New York, is architect.

**Laboratory**—Rockefeller Institute, York Ave. and 66th St., New York, N. Y., awarded contract for construction of a laboratory of animal and plant pathology, also power house, etc. at New Princeton, N. J., to Matthews Construction Co., Princeton. Estimated cost $150,000.

**Laboratory**—St. Peters College, J. S. Dineen, Pres., 144 Grand Ave., Jersey City, N. J., having sketches made for a 10 story, 110 x 130 ft. college building, including laboratories, etc., at Gifford Ave. and Lincoln Park. Estimated cost $750,000. Architect not announced.

**Laboratory**—Treasury Department, Office of Supervising Architect, Washington, D. C., will receive bids until January 8 for construction of a group of buildings, including laboratory and storage building, etc., at U. S. Marine Hospital, San Francisco, Calif.

**Laboratory (Research)**—Bureau of Yards & Docks, Navy Dept., Washington, D. C., will soon award contract for extension of building at Naval Research laboratory, Bellevue.

**Laboratory (Research)** — Calumet & Hecla Consolidated Copper Co., Calumet, Mich., and 25 Broadway, New York, N. Y., plans construction of a research laboratory at Lake Linden, Mich. Estimated cost $100,000. Maturity indefinite.

**Laboratory (Science)**—State Dept. of Institutions and Agencies, Trenton, N. J., will receive bids until January 4 for construction of an agricultural science building at New Brunswick. Estimated cost $280,000. C. N. Leathem, Jr., State Bldg., Trenton, is architect.

**Laboratories** — Board of Commissioners, J. Wasser, Clk., City Hall, Jersey City, N. J., will receive bids about February 1 for construction of three laboratory and two hospital buildings at Medical Centre. Estimated cost $5,000,000. J. T. Rowland, 30 Journal Sq., Jersey City, is architect.

**Laboratories**—Board of Regents, University of Texas, c/o J. W. Calhoun, Comptroller, Austin, Tex., will soon receive bids for construction of a group of buildings including physics, engineering and geology buildings, economic building, etc. on University campus. Estimated cost $2,400,000. Herbert M. Green, La Roche & Dahl, Insurance Bldg., Dallas, are architects.

**Laboratories** (Physics, Chemistry and General Science)—Board of Education, Shaler Township, F. C. Kaufman, Pres., Glenshaw, Pa., awarded contract for construction of a 3 story, 88 x 228 ft. elementary and high school including physics, chemistry and general science laboratories on Mount Royal Blvd. to Fairchance Lumber Co., Fairchance, Pa. Estimated cost $220,000.

**Leather Goods Plant**—Lion Leather Goods Co., D. Petrie, Pres., Los Fresnos, Tex., plans construction of a 2 story, 40 x 90 ft. plant. Private plans. Equipment including stamping, cutting machines, etc., will be required.

**Lime Kiln**—Joseph B. Noel, Big Springs, Tex., acquired 320 acres of land at Big Springs for mining purposes. Will construct a lime kiln, probably by day labor.

**Paint and Varnish Factory Addition**—Baltimore Paint & Color Works, 148-156 South Calverton Road, Baltimore, Md., plans 1 story, 34 x 100 and 25 x 28 ft. additions to paint and varnish factory.

**Paper Mill**—St. Regis Paper Co., 60 East 42nd St., New York, N. Y., will not construct paper mill at Tacoma, Wash. Project abandoned.

**Paper Mill Addition**—Marathon Paper Mills Co., Wausau, Wis., plans construction of a 1 story, 54 x 70 ft. addition to paper mill on Young St.

**Paper Plant**—Osborne Paper Co., Marion, Ind., awarded contract for a 2 story paper plant to C. W. Barley, Marion. Estimated cost $40,000.

**Perfumery Plant**—V. J. Curcio, 217 Custer Ave., Jersey City, N. J., plans to rebuild 2 story perfumery plant destroyed by fire. Estimated cost $40,000. Architect not selected.

**Pottery Plant**—Mayer China Co., Beaver Falls, Pa., plans to rebuild mould factory and power plant at Second Ave. and Fourth St., destroyed by fire. Estimated cost $200,000. Private plans.

**Refinery**—Gladewater Refining Co., Gladewater, Tex., plans construction of a casinghead gasoline refinery, 4,000,000 cu.ft. daily capacity in East Texas fields. Estimated cost $100,000.

**Refinery**—Marathon Oil Co. and Mid-Kansas Oil & Gas Co., Tulsa, Okla., plan enlargement of oil and gas refinery including additional unit at Bristow. Estimated cost $200,000.

**Refinery** — Alfred Peter, 207 Market St., Newark, N. J., Archt., will receive bids until December 18 for construction of a 2 story refinery for owner, c/o architect. Estimated cost $40,000.

**Refinery**—Rio Grande City Oil Co. et al., Rio Grande City, Tex., plans construction of an oil refinery. Estimated cost $175,000. Private plans.

**Refinery**—Tex-York Utilities Corp., Meraux, La., plans additions and re-equipping of refinery. Estimated cost to exceed $1,000,000. Work will be done by day labor and separate contracts.

**Refinery**—United Refining Co., H. A. Logan, Pres., Warren, Pa., plans to rebuild compressor unit destroyed by fire. Exceeds $40,000. Work may be done by day labor and separate contracts.

**Refinery, etc.**—Swift Canadian Co., Ltd., 17 Water St., Vancouver, B. C., receiving bids for construction extension additions to packing plant at New Westminster. Plans include hog fuel shed, refinery building, boiler house and new smokestack. Estimated cost including equipment $60,000.

**Refinery (Oil)** — Octane Oil Refining Co., Baird, Tex., will build an oil refinery near Baird, 1,500 bbl. of crude oil daily capacity. Estimated cost $250,000. Private plans. Most of work will be done by day labor.

**Refinery (Oil)**—Security Oil & Refining Co., Howell, Ind., will build an oil refinery by owner's forces. Estimated cost $60,000.

**Refinery (Oil)**—Standard Oil Co. of Ohio, 526 High St., Toledo, O., acquired Solar Refining Co.'s plant and plans additions and reconstruction. Work will probably be done by day labor and separate contracts.

**Rubber Plant**—Canton Rubber Co., 211 7th St. S. E., Canton, O., plans construction of a plant for the manufacture of rubber gloves in England. Leeds and Manchester have been named as possible locations.

**Rubber Factory** — Tyson Bros., Woodbridge, N. J., c/o Gardner Industrial Corp., Gardner, Mass., having plans prepared for a 2 story factory for the manufacture of rubber substitutes at Gardner. Private plans.

**Shell House and Magazine**—Bureau of Yards & Docks, Navy Dept., Washington, D. C., awarded contract for a 1 story, 50 x 100 ft. shell house and magazine at Naval Ammunition Depot, Lake Denmark, N. J. to McCay & Kirkland, 23 West Mount Royal Ave., Baltimore, Md. Estimated cost $150,000.

**Soap Manufacturing Plant**—Lever Bros., 371 7th Ave., New York, N. Y., awarded contract for superstructure of 1 and 2 story soap manufacturing plant, including 60 x 100 ft. refinery, 60 x 115 ft. deodorizing building, 65 x 180 ft. finishing building, and 60 x 65 ft. boiler house on River Road, Edgewater, N. J., to White Construction Co., 95 Madison Ave., New York, N. Y. Estimated cost $40,000.

**Soap Factory** — Los Angeles Soap Co., 617 East First St., Los Angeles, Calif., awarded contract for construction of first unit of soap factory, 1 story, 140 x 268 ft. at Vignes, Turner and Banning Sts., to Schuck Construction Co., 1937 West 62nd St., Los Angeles. $65,000.

**Steel Strip Mill**—Republic Iron & Steel Corp., 335 Market St., Youngstown, O., plans construction of a strip mill at Massillon. Estimated cost $500,000. Private plans. Maturity probably this winter.

**Anti-Septic Manufacturing Plant** — Zonite Products Ltd., 405 Lexington Ave., New York, N. Y., will soon let contract for construction of anti-septic manufacturing plant at Ste. Therese, Que. Estimated cost to exceed $40,000.

# INDUSTRIAL NOTES

FEDERATED METALS CORP., Newark, N. J., has appointed Samuel Frankel director of sales of the special alloys department.

WHITING CORPORATION, Harvey, Ill., has absorbed the Grindle Fuel Equipment Co., a subsidiary in the past, as a department under the name pulverizing and combustion equipment division.

DURIRON CO., INC., Dayton, Ohio, has appointed H. D. Rogers as representative at 528 Leader Building, Cleveland, Ohio. At Buffalo a direct sales office is being opened at 220 Delaware Ave., under G. A. Baker.

NEILAN CO., LTD., has removed its New York office to 19 Rector St.

PHILFUELS CO., has changed its corporate name to Philgas Co. for convenience to the trade, without any accompanying changes in the organization.

MASON REGULATOR CO., Boston, Mass., has acquired the business of the Neilan Co., Ltd., Los Angeles.

SHELDON, MORSE, HUTCHINS & EASTON is the name of a new marketing organization to be devoted to all branches of industry, engineering, and science. The offices are located at 191 West 10th St., New York City. Among the four founders are Dr. Sheldon, of New York University, and L. W. Hutchins, of the Swann Corporation.

LINCOLN ELECTRIC CO., Cleveland, Ohio, has moved its New York office to the McGraw-Hill Building at 330 West 42nd St., with G. N. Bull in charge.

NORTHERN EQUIPMENT CO., Erie, Pa., has appointed I. M. Day representative at 306 Chandler Bldg., Washington, D. C., and G. L. Simonds, Winter Haven, Fla., as representative for Florida.

FOXBORO CO., Foxboro, Mass., has acquired the business of the Wilson-Maeulen Co. and will incorporate it as a division at the end of this year.

# CHEMICAL & METALLURGICAL ENGINEERING

VOLUME THIRTY-EIGHT . . . NUMBER TWELVE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**Number of Copies Printed This Issue 13,280**

# ATTENTION!

**Here's the answer to that problem of—*which is the cheapest*—shipping in Hackney permanent steel barrels or single trip containers.**

**EXAMPLE**

In 1929—"A" Company spent $46,500 for light weight containers which were used to make only one trip.

In 1930—this same company changed to Hackney returnable steel barrels, reducing their costs to $17,260. On the same volume of business which they did in 1929, their costs would have been about $21,576 —making a saving of better than 50%.

This is only one of many examples which show why Hackneys are used by many companies, both large and small—for shipping various liquid and dry bulk materials.

During the past 30 years, Hackney has consulted with a great number of manufacturers in working out the most economical solutions to their shipping problems. This service is open to you, without obligation. It may be the means of making a substantial saving in your shipping costs. Write us today.

**A Few Prominent Hackney Users**

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Missouri Pacific R. R.
Tanglefoot
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Hercules Powder
Delco Light

1325 Vanderbilt Concourse Bldg., New York City
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PRESSED STEEL TANK COMPANY

5709 Greenfield Ave., Milwaukee, Wis.
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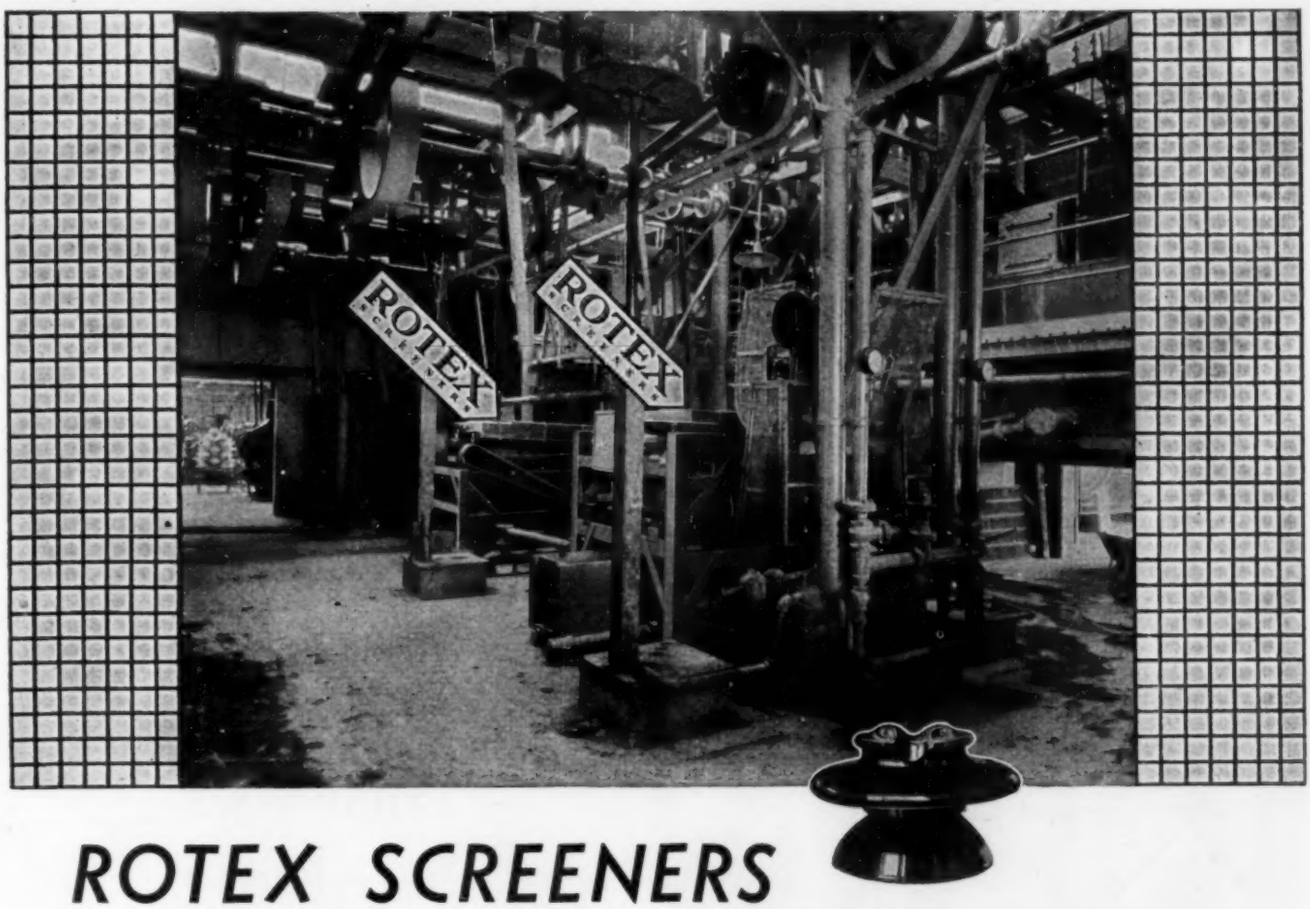
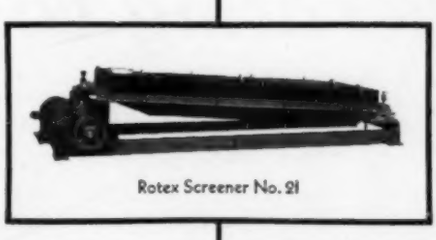
**Hackney**
**MILWAUKEE**




# ROTEX SCREENERS
## increase production for LOCKE Insulators

In the production of electrical insulators, screening (or lawning as it is called) is an important process. The clay slips must be carefully screened to eliminate all lumps and foreign particles.

Rotex Screeners are the ideal machines for this purpose. An executive* of the Locke Insulator Corporation says of Rotex Screeners, "Eight years ago we replaced our vibrating lawns with Rotex Screeners. We have found Rotex Screeners to be much more efficient than our old method. They have enabled us to lower our production costs through decreased maintenance and greater production. We have found also that much more slip can be lawned in a given time with Rotex Screeners than with our previous machines. In addition our experience has been that the wire screens on the Rotex machines last longer than they did with the vibrating system".


Rotex Screener No. 21

Rotex Screeners can do the same for you as they are doing for Locke! And here is how we can show you definite proof. Send us 50 to 100 pounds of the material you screen. We will test it in our laboratory, carefully weighing and checking each separation. Then we will submit a complete report of the test, together with samples of the screening and our recommendation on the proper type of Rotex for your job.

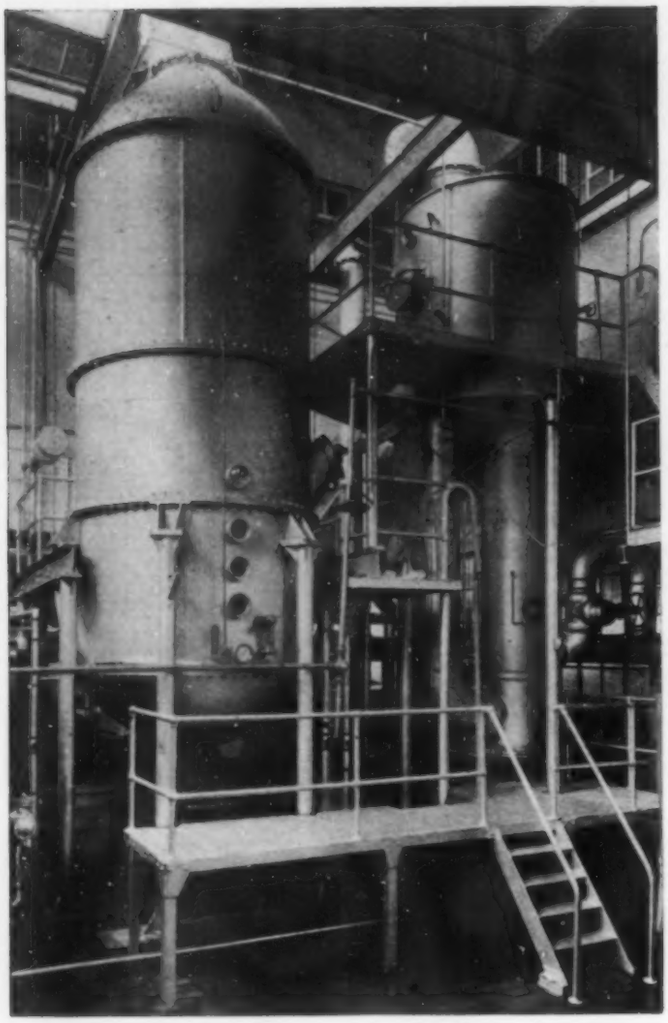
Don't wait—don't delay, get in touch with us at once. Call your stenographer. Tell her to get a note to us at once, asking for further details. No obligation whatever—that is understood.

*Name on request.

THE ORVILLE SIMPSON COMPANY, 1252 Knowlton St., Cincinnati, O.

*Branch Offices,* NEW YORK AND CHICAGO

# ROTEX
## SCREENERS



BUFLOVAK

DRYERS

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CHEMICAL CASTINGS

CHEMICAL PLANT EQUIPMENT

# MODERNIZATION ~ *Cuts operating cost in half!*

HALF as much steam and half as much cooling water mean just about half as much operating cost. That is what modernization of evaporating equipment has done in this plant.

The former evaporator was rebuilt, — equipped with an outside heating element. Then it was connected as the first effect to a modern BUFLOVAK unit.

There is a two-fold saving from this unique double effect evaporator, because the investment cost was lowered, in addition to reducing the operating costs.

For more than twenty-five years, BUFLOVAK engineers have been designing and building cost-saving, process equipment. They will gladly share this experience with you, without any obligation.

Besides BUFLOVAK maintains a Research Laboratory, completely equipped with working units. Here the engineers' recommendations may be proven in semi-plant operating, conditions.

Literature, describing BUFLOVAK Process equipment will be sent on request.

**BUFFALO FOUNDRY & MACHINE CO.**
**1551 Fillmore Ave., Buffalo, N. Y.**

In Canada: BUFLOVAK COMPANY OF CANADA LIMITED
330 Bay St., Toronto

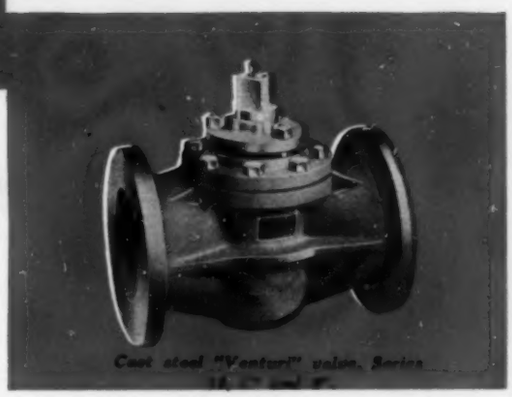
# NORDSTROM VALVES

"Merco" bronze valve, 150 lb. working pressure, 1" to 3".

"Mercoloy" valve, 75 lb. working pressure, 4" to 8".

## —effectively protected against corrosion and erosion

## Embody patented "Sealdport" lubrication



Cast steel "Venturi" valve, Series

Nordstrom Valves have long been the preferred control of lines in chemical plants requiring an absolute shut-off, freedom from sticking and complete protection to the operating parts against corrosion and erosion.

Nordstrom Valves are made in various metals to meet the special requirements of specific services. These metals include iron, semi-steel, "Mercoloy", "Merco" bronze and aluminum.

The "Sealdport" lubrication method provides for the proper lifting of the plug in any position by lubricant pressure and positive distribution of the lubricant in two unbroken rings around both ports of the valve when in the shut-off position. The plug can be rotated 360 deg. without permitting escape of the line fluid or gas to the atmosphere by way of the lubricant ducts.

Catalog No. 8 completely describes the various valves for chemical services.

MERCO

**MERCO NORDSTROM VALVE COMPANY**

SUBSIDIARY OF THE MERRILL COMPANY . . ENGINEERS

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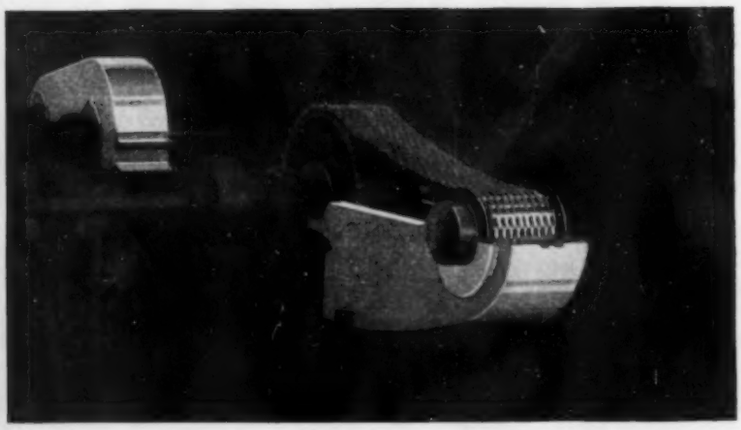
***Phantom view of Nordstrom Valve showing application of lubricant through channels and ducts to the seat beneath plug. A turn of the lubricant screw applies force.***

P. I. V. GEAR—Variable Speed Transmission
For Positive, Infinitely Variable Speed Control. Book No. 1274.



SILENT CHAIN DRIVE
For High Speed Power Transmission. Data Book 125, and Stock List 725.

HERRINGBONE GEAR SPEED REDUCER
For Large Reductions, Heavy and Shock Loads. Book No. 815.

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WORM GEAR SPEED REDUCER
For Positive Driving in Confined Space. Folders Nos. 1086 and 1191.

## LINK-BELT POSITIVE DRIVES *Include:*

Link-Belt Silent Chain Drives - - - Roller Chain Drives
Herringbone Gear Speed Reducers - Worm Gear Speed Reducers
P. I. V. Gear (Positive, Infinitely Variable Speed Transmission)
Chain Drives of all types (Malleable Iron, Promal or Steel)
Herringbone Gears

# LINK-BELT

# *Put your* POWER TRANSMISSION PROBLEM *up to* LINK-BELT

## POSITIVE DRIVE SPECIALISTS

BECAUSE . . . we make every type of Positive Drive apparatus, and our experience in applying them correctly is yours for the asking.

Our Positive Drive Specialists are unbiased in their recommendations. Profit by their extensive experience in solving all kinds of power transmission problems. No task is too small or too large for Link-Belt.

Now is a good time to ask us for recommendations. Drive your equipment with Link-Belt non-slipping, positive drives. Send for Positive Drive Data Books mentioned.

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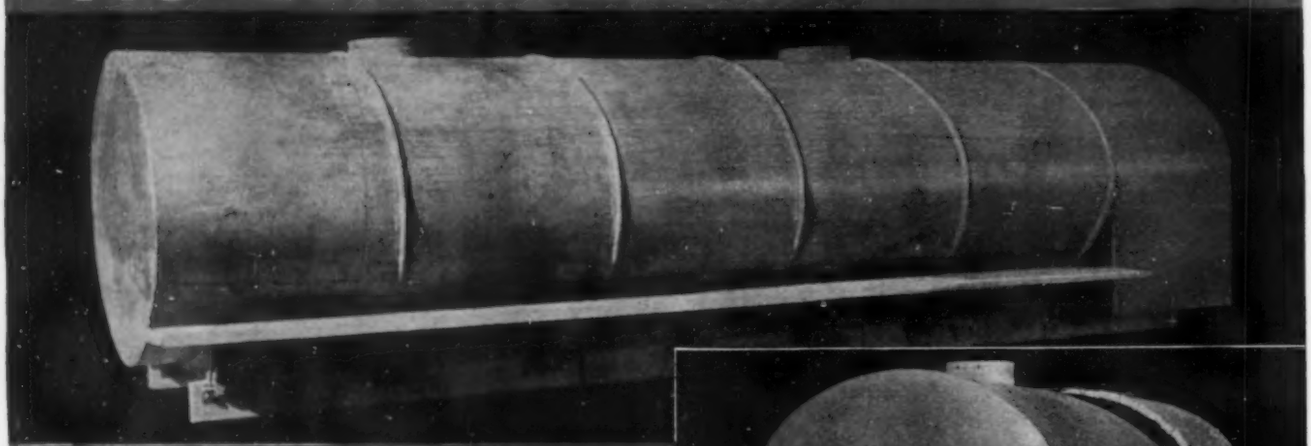
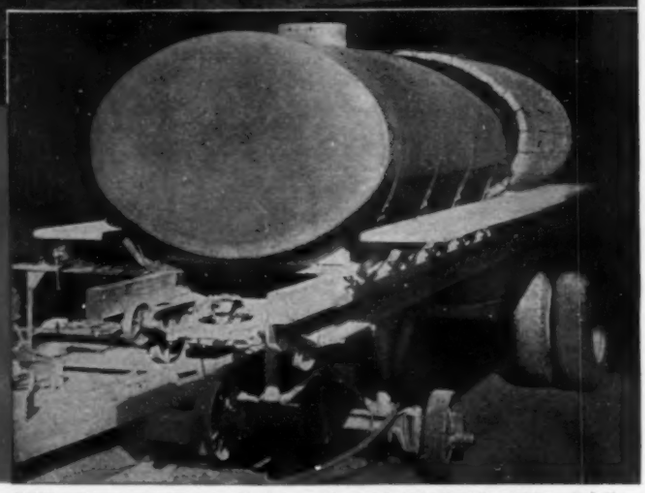
**Positive DRIVES**

# No Corrosion . . . . No Contamination . . . .



## This Sugar Syrup Truck Tank Is Made Of Lukens Nickel-Clad Steel Plate



2,000 gallon truck tank made from Lukens Nickel-Clad Steel Plate, 1/4" in thickness, with Nickel layer 10% of the overall thickness. Built by United Dry Docks, Inc., 11 Broadway, New York, N. Y., the truck tank will be used by a prominent sugar refining company for the transportation of sugar syrup

COMPOSED of a layer of pure, solid Nickel permanently bonded to a base plate of steel, Lukens Nickel-Clad Steel Plate is the hot-rolled bi-metal plate that makes it economically possible to obtain the advantages of pure, solid Nickel construction in tanks, pressure vessels and other heavy plate work.

Immune to corrosion in the same degree as pure, solid Nickel, Lukens Nickel-Clad Steel Plate prevents iron-contamination and product discoloration. It is already serving efficiently and economically in tank cars handling liquid caustic soda, dyeing tanks, filter tanks, brine kettles, evaporators, formaldehyde storage tanks, soap boiling kettles, fruit juice deaerators, and many other applications throughout the chemical and allied industries.

Lukens Nickel-Clad Steel Plate is rolled in thicknesses of 3/16" and heavier (with pure Nickel 10% or more of the total thickness) and in widths and lengths up to the extreme limits of the Lukens 206" rolling mill . . . the World's Largest Plate Mill. Formed heads of all types are also available.

Before you buy new equipment requiring corrosion-resistance, investigate the economy of Lukens Nickel-Clad Steel Plate. Complete data will be sent you promptly, if you will write or fill in and mail the coupon below.

## LUKENS NICKEL-CLAD STEEL PLATE

**LUKENS STEEL COMPANY**

COATESVILLE, PENNSYLVANIA

Lukens Steel Company, Coatesville, Pennsylvania
Send complete data on Lukens Nickel-Clad Steel Plate for use in:

.....

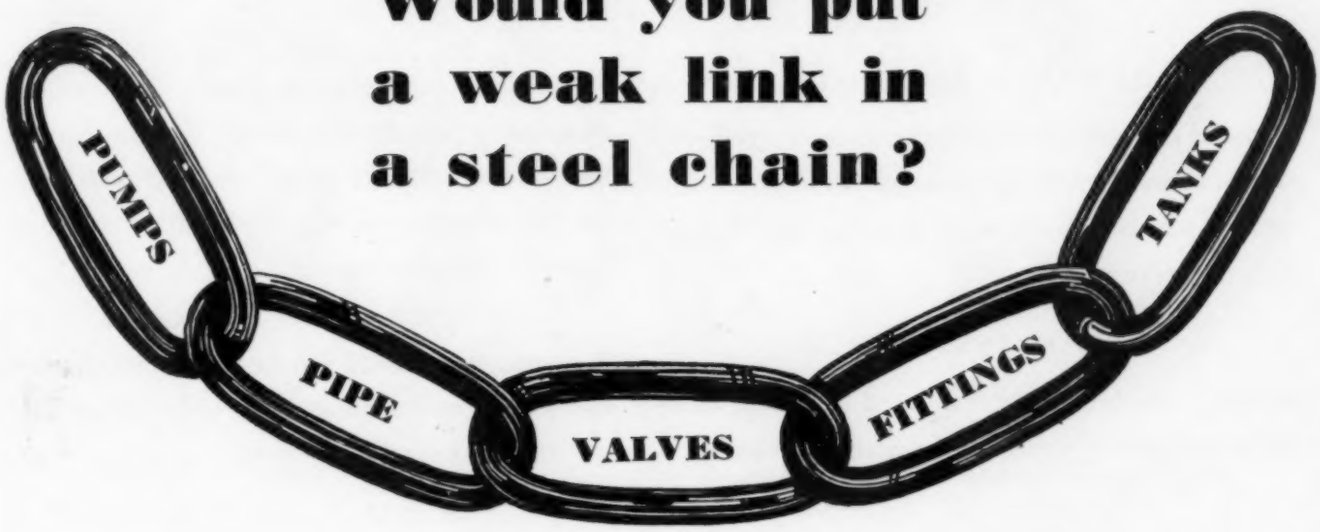
Name and Title .....

Company .....

Address .....

(C&ME 12-31)

# Would you put a weak link in a steel chain?




# RESISTO *Matched Parts* keep "Weak Links" out of your corrosives handling system

A WEAK link has the same effect on your corrosives line as on a heavy steel chain. A little extra pressure—just one piece of equipment gives way—and the whole system snaps!

From this fact springs the importance of *RESISTO Matched Parts.* No weak points in a line equipped from beginning to end by RESISTO. Pipes . . valves . . fittings . . pumps . . tanks . . . . all form a strong, dependable chain through which your corrosive liquids flow freely, with lowered corrosion costs all along the line.

That's the important thing—*all along the line!* A RESISTO product cannot give you full savings if those savings are eaten up by inferior equipment ahead of it. You've got to have *matched parts —matched performance*—to handle the most liquid per dollar cost.

RESISTO can equip your entire handling system with *matched parts* that work together for savings in corrosion. Write for details of RESISTO equipment or send specifications for quotation.

RESISTO
REGISTERED TRADEMARK

*Pipes, valves, fittings, pumps, tanks, castings, special equipment. Made of hard lead, chrome alloy, hard rubber; or lined with lead, tin or rubber. Contracting lead burners.*

RESISTO can now supply refractories, including "Hydrecon" Write for details.

## RESISTO PIPE & VALVE CO.

262 BRIDGE ST., CAMBRIDGE, MASS.

New York Sales Office, 30 Church St. 75 E. Wacker Drive, Chicago, Ill.

1111 BEAVER HALL HILL, MONTREAL, CANADA

# FOR THE CHEMICAL PROCESS INDUSTRIES

### CONSTANT STRENGTH

A vessel possessing a constant known strength, rather than a varying strength difficult to ascertain without further weakening the vessel with inspection scars.

### EASE OF INSPECTION

A vessel which is easily inspected any time without necessitating removal of protective coatings.

### ENDURANCE

A coating which will stand all the abuses to which the unlined vessel is subjected without danger of removal of protection through spalling or undercutting.

### HEAT-EXCHANGE

A coating which will not heat-insulate the vessel, nor will it cause undue stress to be set up during heating and cooling periods.

**A. O. SMITH CORPORATION**

*General Offices: Milwaukee, Wisconsin* - PRESSURE VESSEL DIVISION

SMITH*Welded*-SMITH*Lined Still for Newport Industries Inc.—72 i. d.—12′ 7⅜″ Overall Length*

# SMITHWELDED

# METALLIC LINING OF PRESSURE VESSELS

## BY THE A. O. SMITH CORPORATION

First perfected to resist the highly corrosive crudes in oil-cracking processes, the SMITHLined vessels were soon recognized as a solution to many phases of the age-old corrosion problem in pressure vessels for chemical processes.

Suitable metallic linings have been applied to meet known conditions. Technique has been developed to test their value in the face of specific operating conditions in advance of the time that new equipment is needed.

Shown on this page is an illustration of the type of lining used for a SMITHLined-SMITHWelded Jacketed Still recently completed for the Newport Industries Inc.

### *In Summary— These Vessels Provide:*

SAFETY

Relief to the owner of the ever-present fear of serious pressure vessel explosions, with accompanying loss of life and property.

MAINTAINED PRESSURE

Elimination of the cause for reducing pressure, with accompanying drops in yield and quality of product.

FREEDOM FROM SHUT-DOWNS

Elimination of such shut-down periods as are frequently caused by corrosion.

CONTINUITY OF OPERATION

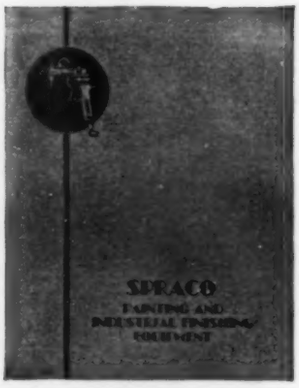
A vessel completely adequate for the intended service, rather than one which must be revamped upon erection and from time to time thereafter.

# SMITHLINED

# SPRACO PRODUCTS

**Spray Nozzles for every industrial purpose**

**Cooling Systems permitting the recirculation of industrial water**




**Spray Guns and equipment for maintenance painting and industrial finishing purposes**

**Please send Bulletin on**

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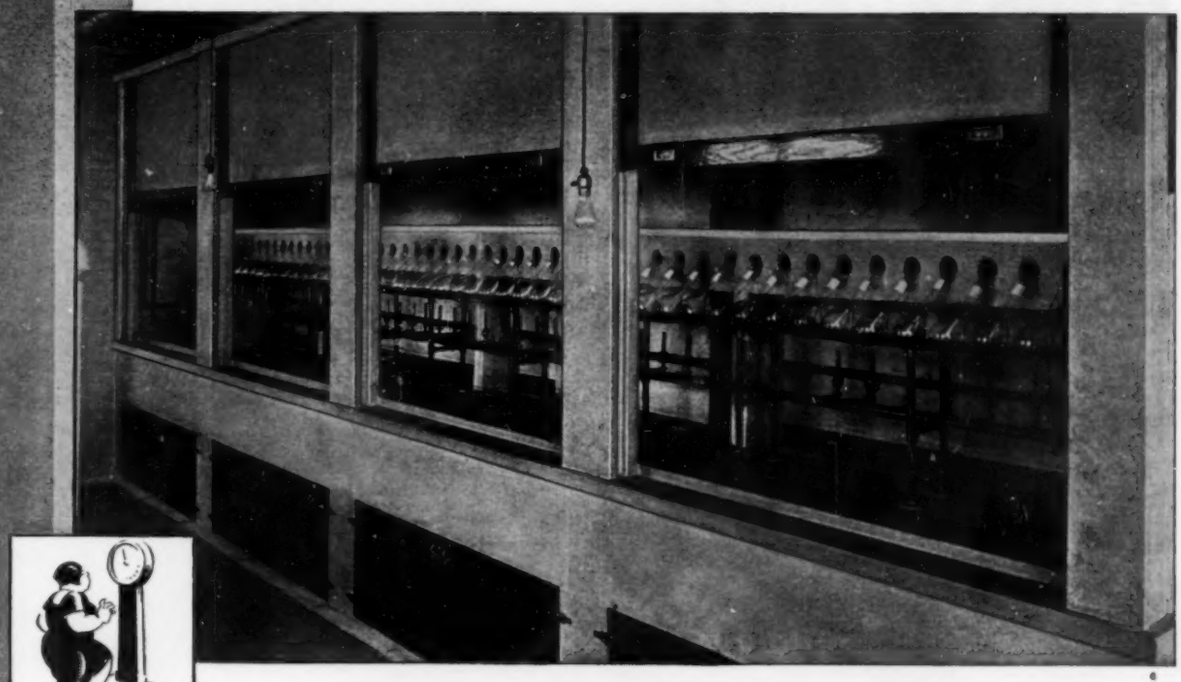
# SPRACO
## INCORPORATED

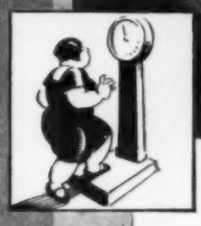
FORMERLY SPRAY ENGINEERING COMPANY

115 CENTRAL STREET SOMERVILLE, MASS.

4346

INDUSTRIAL PROGRESS DEPENDS ON THE SCIENTIST





# The food field is no exception

THE general subject of diets and foods has never been as much in the public consciousness as at the present time. In a large measure this is due to the work of laboratory scientists whose analyses and discoveries have given new significance to food from the angles of nourishment and enjoyment.

The food field is no exception to the rule that resultful work is done in competently equipped laboratories, and the partial list of prominent companies, at the left, indicates that Alberene Stone table-tops, fume hoods and other permanent equipment is the choice of firms who consider the laboratory an important source of selling and production data.

American Sugar Refining Company
Fleischmann Laboratories
Hills Brothers Company
Loose-Wiles Biscuit Company
National Biscuit Company
National Sugar Refining Company
Wilson & Company
H. J. Heinz Company
Swift & Company

ALBERENE STONE COMPANY, 153 West 23rd Street, New York
Sales Offices in Principal Cities. Quarries and Mills at Schuyler, Virginia

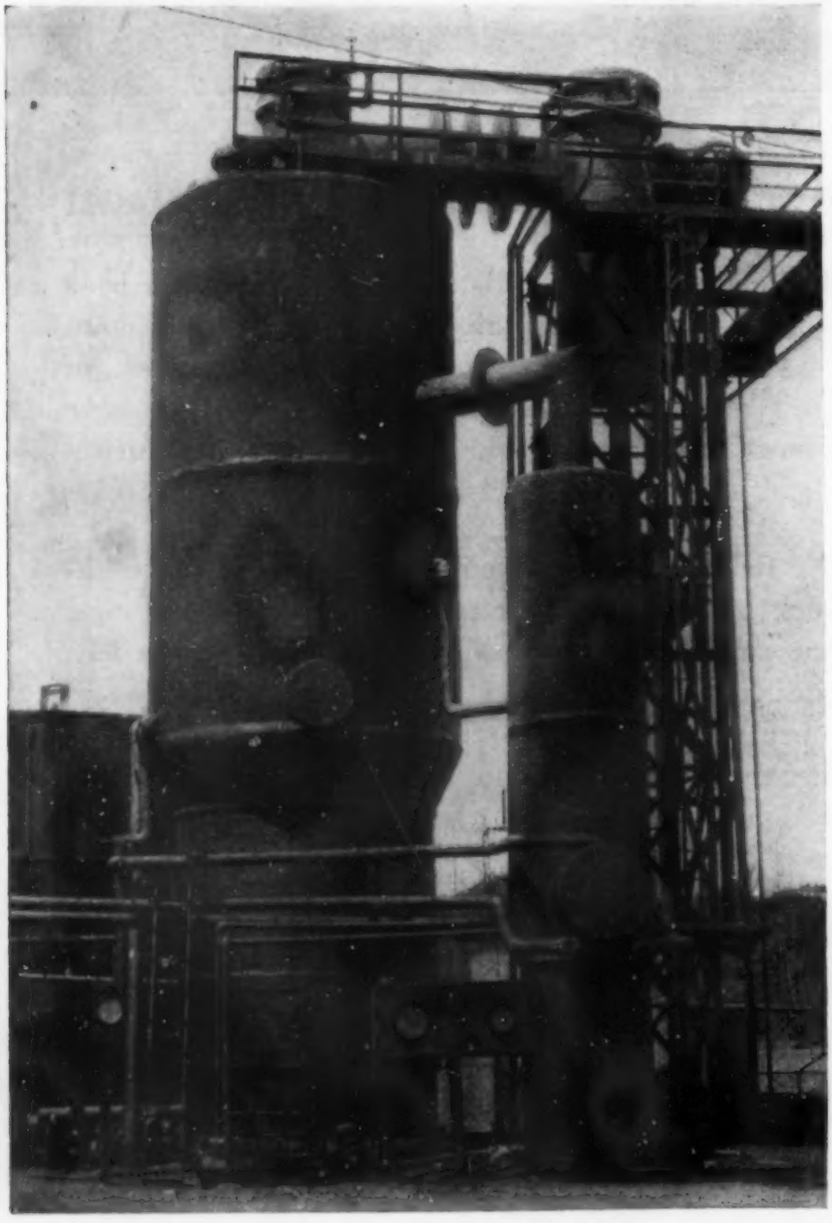
ALBERENE STONE
STANDARD FOR LABORATORY EQUIPMENT

IMPROPER LABORATORY FACILITIES MAY HANDICAP YOUR BUSINESS

# Asphalt refiner cuts blowing time ...improves product with DEVINE VACUUM EQUIPMENT

DEVINE Products are effecting big economies throughout the process industries. The Jas. B. Berry Son's Co. installation at Waterloo, Ark., is a typical example.

They added a Devine Vacuum Tower and Side Stripper to their asphalt refinery equipment to improve separation of light fractions from heavy residuum. Result, blowing time greatly reduced and better grade material produced in oxidizing stills.



•

**CHEMICAL AND PETROLEUM APPARATUS**

**FROM BLUE PRINT TO SHIPMENT UNDER ONE ROOF**

•

J. P. DEVINE MFG. CO.
INCORPORATED
Division of Mt. Vernon Car Mfg. Co.
MT. VERNON . . . ILL.

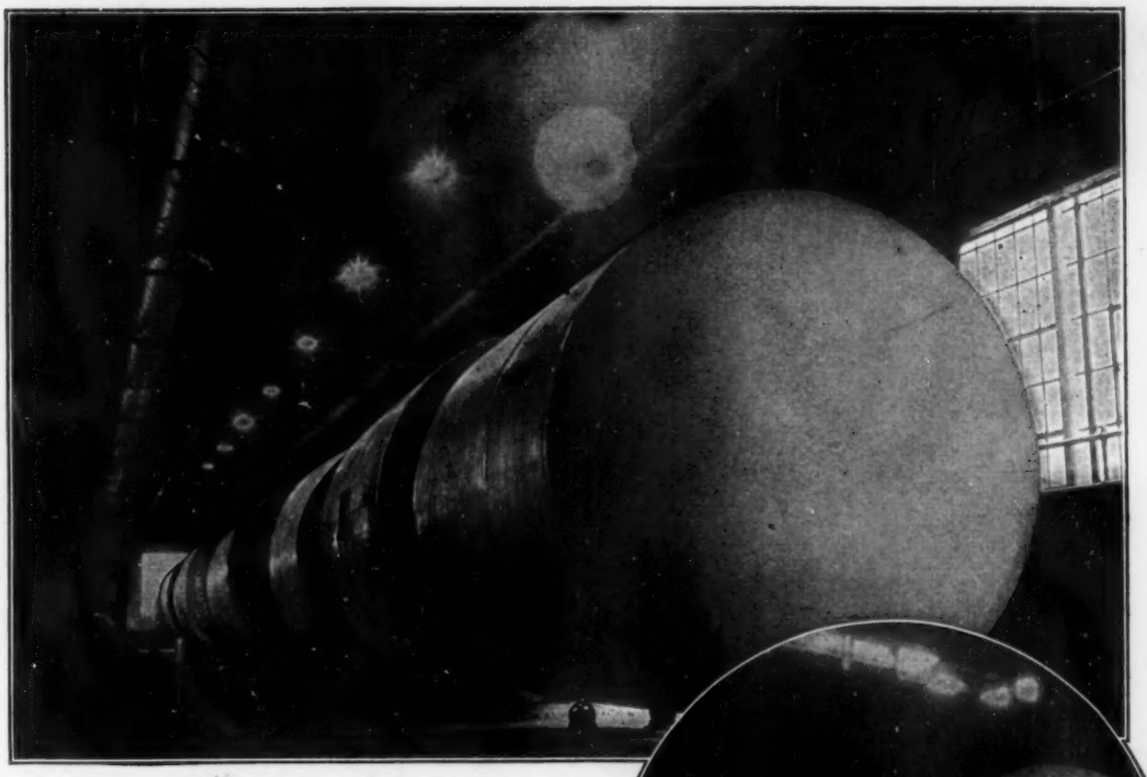
New York Office:
25 West 43rd St.

Chicago Office:
105 W. Madison St.

Fort Worth Office:
2530—5th Ave.

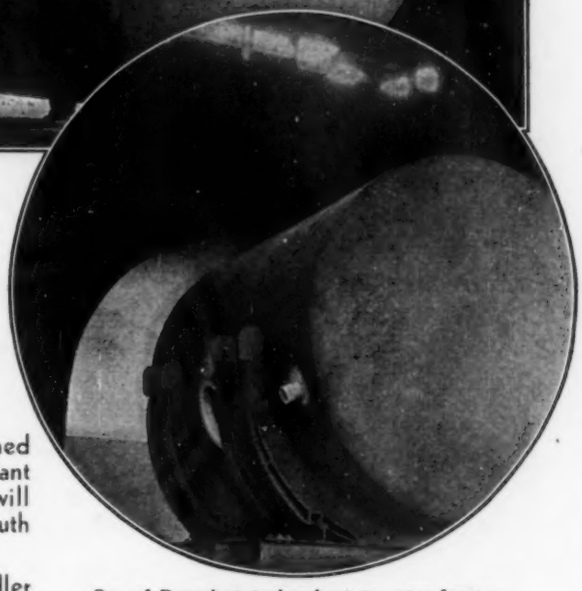
West Coast Representatives:
Beeson Eng. Co., Ltd.,
Los Angeles, Cal.

Canadian Representative:
The John Inglis Co. Ltd.,
Toronto, Ont., Canada.



# PEPSODENT

## buys 100,000 gallons of Pfaudler Storage for antiseptic mouth wash!



One of Pepsodent tanks about to enter furnace where glass enamel is fused into steel shell.

Six of fourteen 7,180 gallon Pfaudler glass lined steel storage tanks shipped to the new Chicago plant of The Pepsodent Co. are shown above. All will be used for storing Pepsodent's Antiseptic Mouth Wash, already an outstanding success.

Pepsodent bought their first piece of Pfaudler equipment in 1919 (a tooth paste mixer), and give evidence of their continued preference by this most recent order.

**IMPORTANT NOTICE**

For the first time in history The Pfaudler Co. will offer a line of small glass lined steel, acid resisting containers, mixers, and storage tanks ranging in size from 5 to 50 gallons. Low priced and finely built, you will find this new development of distinct usefulness in the laboratory or plant. See announcement in next issue.

Pfaudler glass lined steel is a *positive* acid-resisting surface. It is stronger than many alloys, since the steel can be welded permanently and no welded equipment is stronger than its welds. There is no substitute for the cleanliness of glass, nor is any surface as easy to clean. And you *know* when it is clean!

Pepsodent, like many other leading companies, purchased Pfaudler equipment because of *known performance*. That's what counts. Not promises. Let us send you our prospectus. The Pfaudler Co., 1506 Gas & Elec. Bldg., Rochester, N. Y.

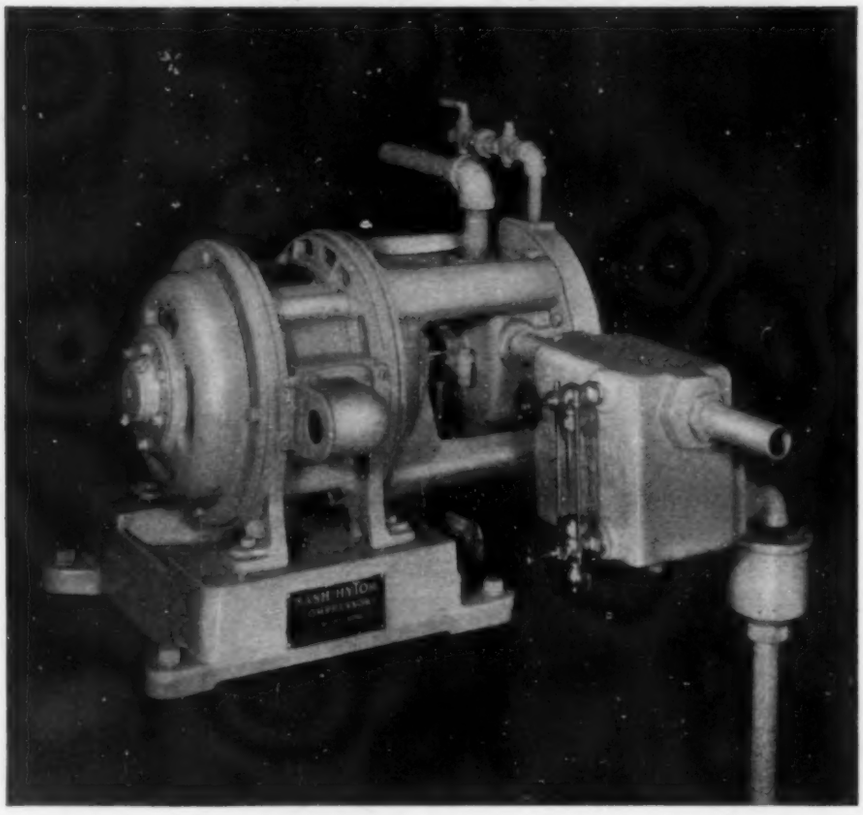
Pfaudler

# GLASS-LINED STEEL

*A clean, lasting, acid-resisting surface*

THE STANDARD WITH WHICH OTHERS ARE COMPARED

# *This* HYTOR COMPRESSOR . . .
## *solves your gas handling problems*



*Nash Hytor Compressors are furnished in a series of sizes with capacities up to 2000 cu. ft. of air per min. Pressures up to 20 pounds per square inch.*

UNIQUE in principle of operation, the Nash Hytor Compressor has many advantages. For example, by employing a special liquid as the displacing medium, the Hytor may be made to provide the solution to a difficult gas handling problem.

Using concentrated sulfuric acid, a standard, cast iron Hytor will simultaneously compress and dry chlorine gas. Or, with oil as the displacing medium, a cast iron Hytor will successfully handle gases having a sulfur content without precipitating the sulfur and without corrosion in the pump.

Write for full information on Nash Hytor Compressors for chemical plant service.

VACUUM PUMPS AND COMPRESSORS FOR AIR AND GAS · RETURN LINE AND AIR LINE VACUUM STEAM HEATING PUMPS · CONDENSATION PUMPS · CENTRIFUGAL PUMPS · SUCTION (SELF-PRIMING) CENTRIFUGAL PUMPS · SUMP PUMPS · SEWAGE PUMPS · PNEUMATIC SEWAGE EJECTORS

NASH ENGINEERING COMPANY, 31 WILSON ROAD, SO. NORWALK, CONN.

# Nash Hytor
VACUUM PUMPS AND COMPRESSORS

# ALLEGHENY METAL BARS CORROSION of Southern black kraft liquors

MANY PAPER MILLS *prefer Allegheny Alloys to withstand action of corrosive agents. Photo shows quadruple effect Swenson Forced Circulation Evaporator (11' 6" high) for handling southern black kraft liquor in plant at Panama City, Florida.*

## Paper industry swings to Allegheny Alloys to withstand attacks of acids.

Every paper mill in the country might profitably use Allegheny Alloys to combat its corrosion . . . to reduce costs . . . to make equipment that will last longer.

For Allegheny Alloys offer you a wide range of resistance to high heat and corrosion to meet almost any need. When you want a metal that withstands more corrosive agents than any other commercially available—specify Allegheny Metal.

If resistance to progressive corrosion is important but surface discoloration does not matter, pick Allegheny 33 (formerly Ascoloy 33). For heat resistance up to 2100°F. Allegheny 44 will be easy to fabricate (formerly Ascoloy 44). For simple fabrication and extreme heat resistance (to 2150°F.) Allegheny 55 is best (formerly Ascoloy 55).

You'll find additional information about Allegheny Metal on the next page. For still more detailed facts about these alloys, write direct.

## NOTICE TO USERS

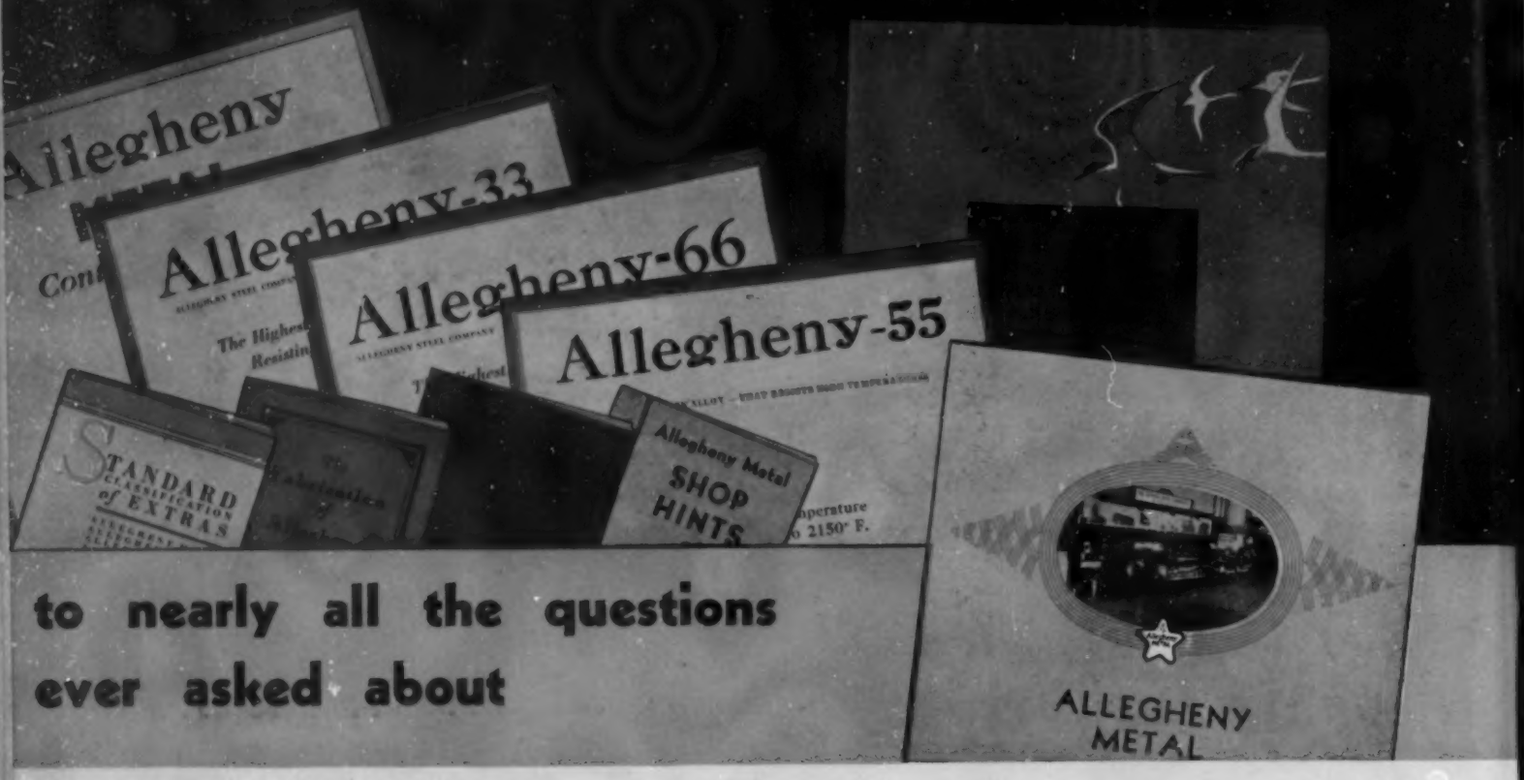
To help you identify more easily the alloys we make, the names all start with Allegheny — our firm name. Changes for simplification purposes are:

Ascoloy 33 is now Allegheny 33.
Ascoloy 44 is now Allegheny 44.
Ascoloy 55 is now Allegheny 55.
Ascoloy 66 is now Allegheny 66.
Allegheny Metal* is still Allegheny Metal

**Allegheny Metal is manufactured pursuant to license from the Chemical Foundation, Inc., under basic patents No. 1,316,817 and No. 1,339,378*

# ALLEGHENY ALLOYS

# Here are the Answers




**to nearly all the questions ever asked about**

# ALLEGHENY ALLOYS

*Manufactured pursuant to license from the Chemical Foundation, Inc., under basic patents No. 1,316,817 and No. 1,339,378*

**WHAT do you want to know about these alloys . . . their ability to withstand corrosion or high heat . . . their strength . . . or the ease with which you can fabricate them?**

**You'll find the answers here, in these five folders, four booklets and the brochure. You'll find the typical analyses, chemical composition, list of effects of various corrosives . . . together with data of fabrication.**

**Any of this literature is yours for the asking. Write today . . . we'll be glad to send it immediately.**

**ALLEGHENY STEEL CO., Brackenridge, Pa.**

*Offices:* New York, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Philadelphia, St. Louis, Milwaukee, Los Angeles. *Warehouse Stocks:* Joseph T. Ryerson & Son, Inc.—Chicago, Cleveland, Milwaukee, St. Louis, Cincinnati, Detroit, Buffalo, Boston, Jersey City, Philadelphia . . . In Canada: Samuel, Son and Co., Ltd., Toronto.

ALLEGHENY METAL Bulletin A—gives complete description of the most highly developed alloy for withstanding corrosion . . . physical data . . . resistance to various media, etc.

ALLEGHENY METAL Bulletin 10—pictures 20 uses . . . gives comparative weight advantages . . . list of installations in hotels, hospitals, steamships, dairies.

ALLEGHENY 33, Bulletin 33—gives complete description . . . suggested uses . . . shapes and sizes . . . physical characteristics . . . corrosion resistance table.

ALLEGHENY 44, ALLEGHENY 55, Bulletin 4455—gives complete descriptions of these heat resisting alloys . . . effect of annealing temperature.

ALLEGHENY 66, Bulletin 66—gives complete description of this chemical resisting alloy . . . corrosion resistance table . . physical data.

SODA FOUNTAIN AND FOOD HANDLING BROCHURE—shows 48 large photos of latest Allegheny Metal equipment in the largest hotels and restaurants . . . two and one-half page list of installations.

THE FABRICATION OF ALLEGHENY METAL—sixteen page booklet giving latest data on handling this alloy . . . data taken from practical work.

ALLEGHENY METAL SHOP HINTS—what to do and what to avoid in working Allegheny Metal . . . technical man's data book of up-to-the-minute information.

WELDING OF CHROMIUM IRONS AND CHROMIUM NICKEL IRON—sixteen pages packed with all the data needed by anyone who welds these alloys.

STANDARD CLASSIFICATION OF PRICES, SHAPES AND SIZES.

Allegheny METAL

Clip the Coupon!

Allegheny Steel Co., Brackenridge, Pa.

*Please send me the literature I have checked:*

- ☐ Allegheny Metal Bulletin A
- ☐ Allegheny Metal Bulletin 10
- ☐ Allegheny 33, Bulletin 33
- ☐ Allegheny 44 and 55, Bulletin 4455
- ☐ Allegheny 66, Bulletin 66
- ☐ Soda Fountain and Food Handling Brochure
- ☐ Fabrication of Allegheny Metal
- ☐ Allegheny Metal Shop Hints
- ☐ Welding Chromium Irons and Chromium Nickel Iron
- ☐ Standard Classification of Extras

Name_____

Firm _____

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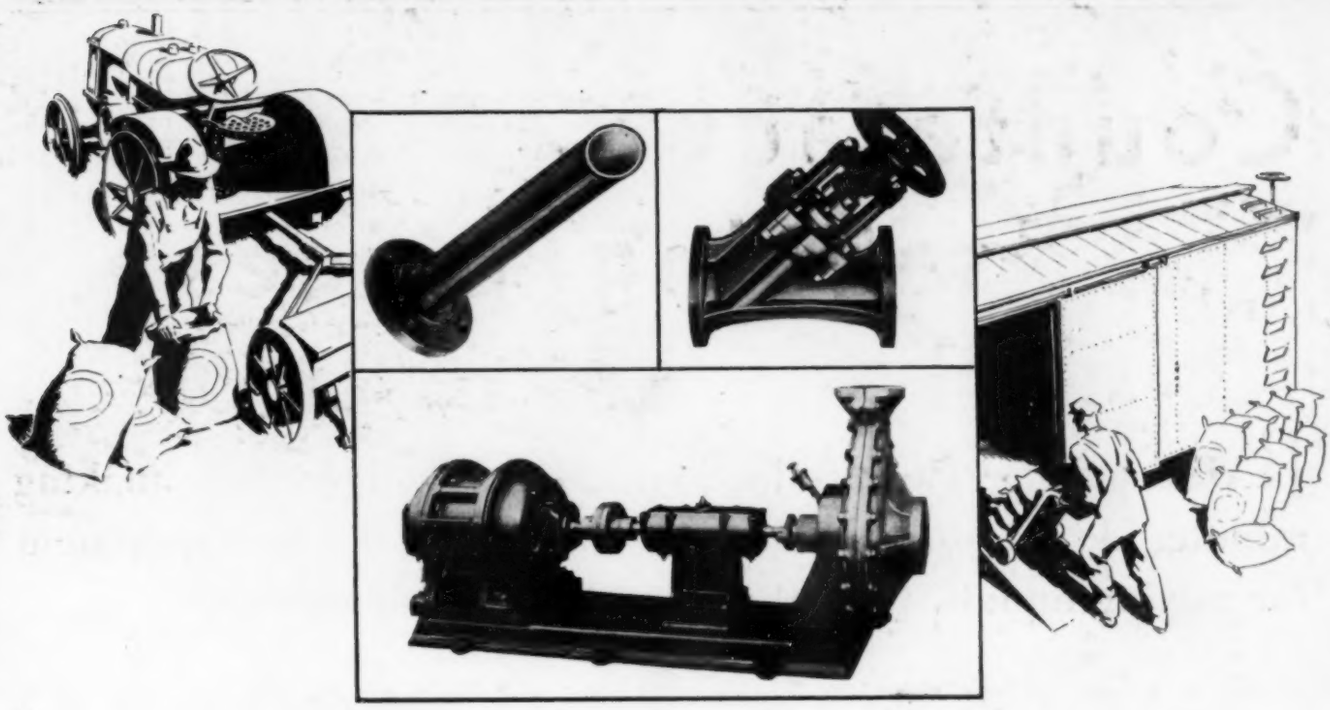
City _____ State_____



## *In the Fertilizer Industry*

# Hardlead and Lead Lined Equipment for corrosive liquor service

FERTILIZER manufacturers have found in Hardlead and lead lined equipment the answer to the problem of handling corrosive liquors. Such equipment possesses the desired combination of properties—strength plus corrosion-resistance.

Under the "United" brand, we make a general line of equipment of this type, including "Chem-Rayon" valves, Hardlead pumps, chemical lead lined pipe and fittings.

"United Chem-Rayon" valves are universally recognized for their strength and durability. They are constructed with a solid Hardlead body, the bonnet being of the same alloy and well reinforced. A Hardlead gland follower is provided, while the handwheel and yoke are of cast iron. Hardlead fins are used for reinforcement of the body, giving additional strength and eliminating unnecessary weight.

"United" Hardlead centrifugal pumps are made with a solid Hardlead case, with the impeller of the same alloy and the shaft of a special acid-resisting metal.

"United Tubond" chemical lead lined pipe has its lining inseparably bonded to the steel and can be depended upon to stand up under rigorous service.

We are also a source of supply for "Homogeneous" chemical lead lined tanks, kettles, digesters, autoclaves, agitators, etc.

**NATIONAL LEAD COMPANY, 111 Broadway, New York, N. Y.**

***Lined Products Department***

*Sole Selling Agents for Homogeneous Chemical Lead Lined Equipment Manufactured by The Treadwell Construction Co. of Midland, Pa.*

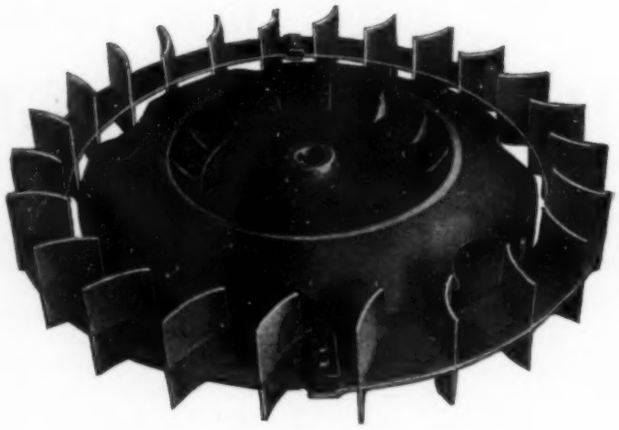
# Counteract sagging prices

●

**RAISE efficiency of production. Many producers are making minutes do the work of hours by means of Turbo-Equipment for mixing liquids with other liquids, solids or gases.**

●

**THOROUGH mixing and unprecedented speed are due largely to the Turbo-Impeller and surrounding ring of stationary CURVED (Patented) deflectors. Turbo-Equipment is available in many types of complete machines, including tanks, mixing units and drives built for continuous service. The design of all parts, the materials and construction are in each case adapted to specific process requirements.**



**Operating data from many fields, laboratory investigation by our specialists, printed matter—all are available to you.**

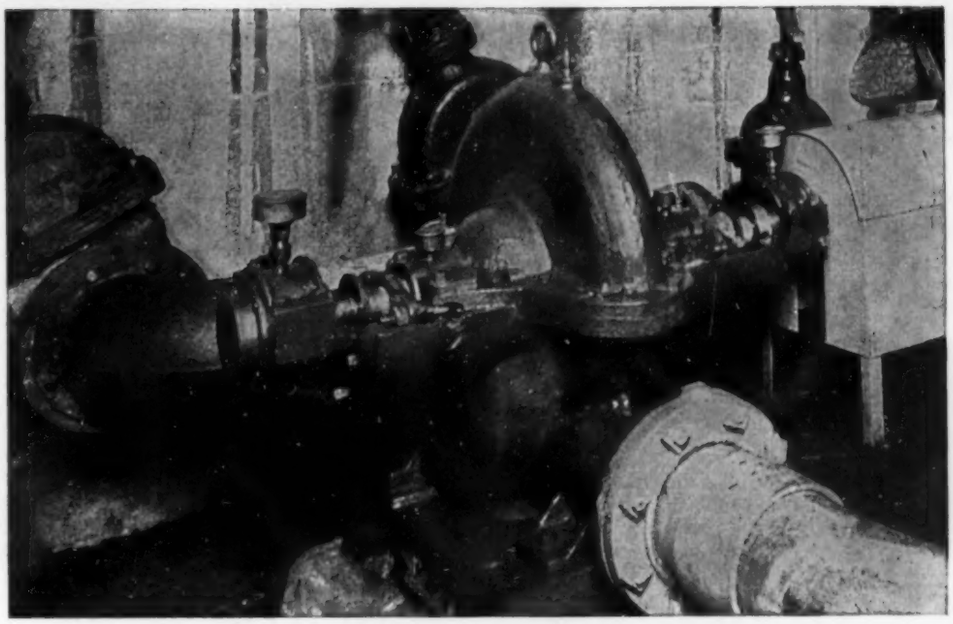
**TURBO-MIXER CORPORATION**

TRADE MARK

CRYSTAL. BLDG., 43RD STREET AT 2ND AVE., NEW YORK, N. Y.
FACTORY AT HUDSON, N. Y.

# TURBO-MIXING EQUIPMENT

5048



# HOW DO YOU CHECK PUMP VALUE?

WHEN specifying pumps for chemical handling, initial cost is seldom the major consideration.

Naturally, a pump that stands out without loss of efficiency under the most severe conditions of corrosive liquid handling should interest you.

That is why the non-corrosive open impeller Hayton centrifugal pump has attracted the attention of chemical engineers throughout the country.

Write for our new bulletin, 160-B11, for detailed imformation on these pumps built for hard service.

*We also offer:*
Meters
Gas Pumps
Blowers
Tanks
Stacks
Gasholders
Steel Buildings
Steel Construction
Galvanizing

HAYTON CENTRIFUGAL DEPARTMENT

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*DIVISION OF INTERNATIONAL-STACEY CORPORATION*

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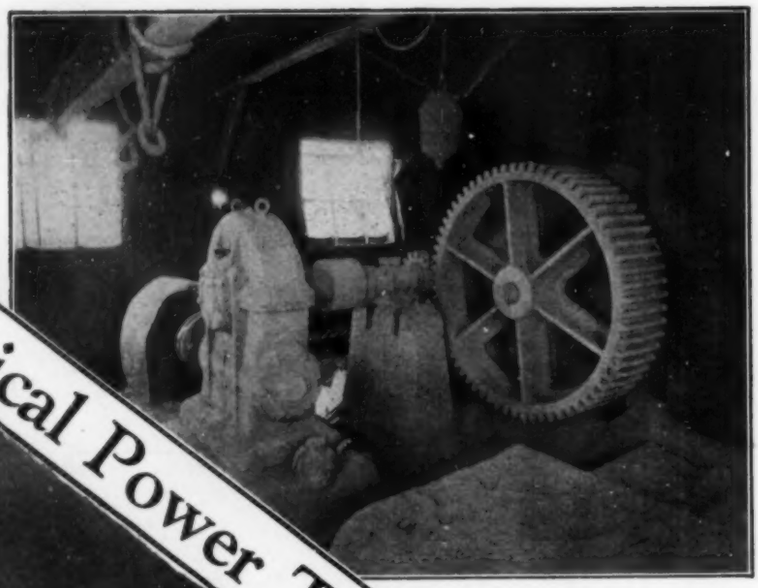
TULSA FT. WORTH HOUSTON BEAUMONT SHREVEPORT LOS ANGELES BUENOS AIRES, ARGENTINE

# For Economical Power Transmission



Philadelphia Worm Unit driving elevator.

Philadelphia Worm Unit driving conveyor belt.

## This Cement Mill is using

# Philadelphia
## SPEED REDUCING UNITS
(ONE NAME-ALL TYPES)

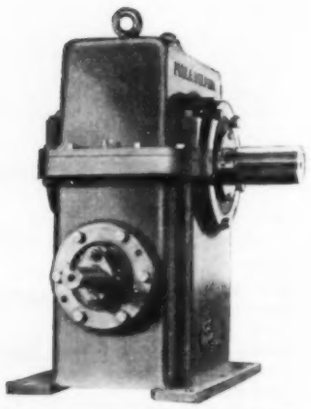
## for many different drive requirements

Driving elevators,—kiln feeders,—conveyor belts,—apron conveyors,—screw conveyors,—are a few of the drives on which Philadelphia Speed Reducers are being used in this cement mill. The many uses for Philadelphia Reducers are made possible by the wide scope of the Philadelphia Line,—they're made in all types, all sizes and ratios.

Many plants in the process industries are standardizing on Philadelphia Units,—they find them economical for driving Agitators, Rotary Kilns, Mixers, Pressers, Glass Lehrs, Coolers, Dyers, Tumblers, Rotary Ovens, Drying Racks, etc.

Wouldn't it pay YOU too, to "standardize" on Philadelphia Units,—to place the responsibility of your Speed Reduction Problems with one manufacturer?

Write us for details and literature about Philadelphia Speed Reducers,—or any other Philadelphia Power Saving Products listed opposite.



**PHILADELPHIA POWER SAVING PRODUCTS**

***Gears***—**Spur, Worm, Herringbone, Internal, Bevel, Miter, Intermittent, Spiral, Helical, Continuous Tooth Herringbone and Spiral Bevel Gears.** ***Non-Metallic Pinions***—**Fabroil, Textolite, Rawhide.** ***Speed Reducer Units***—**All types, all ratios, for all drive conditions.** ***V-Belt Drives***—**A complete line.** ***Miscellaneous***—**Whitney Silent and Roller Chains, Sprockets, Flexible Couplings, Universal Joints, Racks, Ratchets and Pawls.**

Confidence is usually the forerunner of repeat orders—*Phillie Gear*

# PHILADELPHIA GEAR WORKS

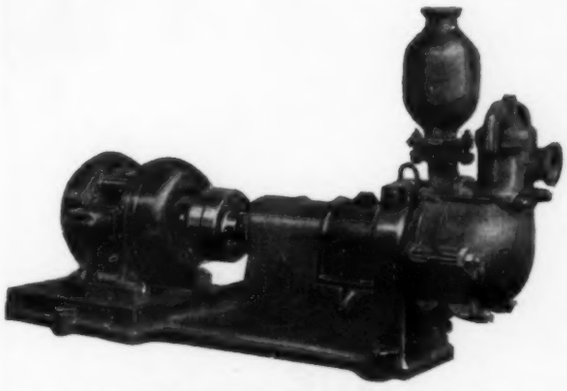
PHILLIE GEAR

Industrial Gears and Speed Reducers
Branch Sales and Engineering Offices:

Erie Avenue and "G" Street, Philadelphia
NEW YORK: 12 E. 41st St.—PITTSBURGH: Farmers Bank Bldg.

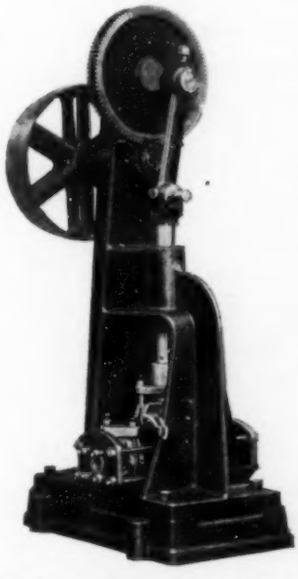
# When it comes to *acid-handling* PUMPS

## . . . industry after industry turns to DURIRON . . . because of known performance



*No. 80 Self-priming Centrifugal Pump*

**Centrifugal Duriron Pumps are built for every corrosive pumping requirement between 20 and 1400 gallons per minute. Sizes range from 2″ suction and 1½″ discharge, to 10″ suction and 8″ discharge. Furnished for direct drive, with or without motor, or for belt drive. The No. 80 shown here is self-priming, maintaining a liquid seal within itself, and so making possible the pumping of liquids which contain entrained air or gas.**



*No. 220 Vertical Reciprocating Pump*

**Duriron Reciprocating Pumps are used for handling relatively small but accurately measured amounts of corrosive liquids to high heads. Furnished for either direct or belt drive. The No. 220, largely installed as a measuring pump, has 1″ suction, 1″ discharge and 4″ stroke. Diameter of piston is 3″. Displacement for one revolution of crank shaft is 1/10 gallon.**

*A few examples taken at random:*

**One of the toughest jobs a pump could have is handling phosphate rock acid slurry in a certain chemical plant. Other pumps would cut out in four to six weeks. *Duriron* Pumps were then installed, and have been in service for over two years, with only one replacement of a casing—a big savings in maintenance expense.**

**For seven years an international electric company has been using Duriron Pumps for transferring hot copper sulphate solution in their electrolytic recovery system, with entire satisfaction.**

**A large dye intermediate plant is using *dozens* of different types of Duriron Pumps as *standard* equipment. Two nationally-known battery companies installed Duriron Pumps for transferring dry battery mix in solution containing a percentage of zinc chloride, which is very abrasive as well as corrosive. They are pleased with the results.**

**Savings over their former method have been reported by one company in lifting acids over Glover and Guy-Lussac towers with Duriron Pumps. A sizeable reduction in the cost of handling soldering flux containing amounts of hydrochloric acid and chlorides, has resulted from a Duriron installation in another plant.**

**In leather tanneries Duriron Pumps are transferring chrome liquor *without contamination or corrosion*. Food industries equip with Duriron for similar reasons in handling vinegar, fruit juices, condiments and processing liquors.**

**In other plants Duriron Pumps are handling, transferring and circulating leaching solutions, pickling and plating solutions, tin tetrachloride, solutions of mud and kieselguhr, hot dilute acids and char—practically every sort of corrosive and erosive liquid.**

**If you are beset by the problem of high maintenance and replacement costs of pumps, we urge you to profit by the experience of these plants and scores of others that can be cited. Ask about our engineering analysis, a complete service that gives you a real basis for decision.**

**THE DURIRON COMPANY, INC.**
**424 N. Findlay St., Dayton, Ohio**

**DURIRON**

# We've Made the Touchdowns!

¶ And our customers tell us we've never shown better form in all departments of the game. We'll endeavor to carry our honors with becoming modesty, but we can't refrain from pointing out those features of our service that have made Gears by Earle so increasingly popular.

¶ Accuracy, economy and reliability are the big three — Earle Gears are always as specified, always moderately priced, and always delivered on time. And it's a real gear service; our estimates and recommendations are consistently lowering the gear expenditures of leading users everywhere. Send along your specifications for any kind of gear and let us prove it with figures. Or ask for our new catalog, using the coupon for convenience.

THE EARLE GEAR & MACHINE COMPANY

4721 Stenton Avenue, Philadelphia, Pa.

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26 Charles Street, London, England

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No. 5 Shiba Park, Tokyo, Japan

THE EARLE GEAR AND MACHINE CO.
4721 Stenton Ave., Philadelphia, Pa.

Please mail me without any obligation on my part, your New Catalog No. 31.

Name.....

Company.....

Street No.....

City.....State.....

**EARLE for all GEARS**

# WHAT the Carborundum Company Recuperators are Doing in a Noted Glassware Plant—

To reverse the usual order and begin with a summary, these recuperators are saving $4680.00 per year on three glassware units.
But that isn't all of the story—

In detail the three recuperators are used in conjunction with three 10-foot pots, each producing 65,000 lbs. of glass daily.

We guaranteed to reduce gas consumption from 51,000 cu. ft. when operating with clay recuperators to 48,000 cu. ft. of 1,150 B. T. U. gas daily.

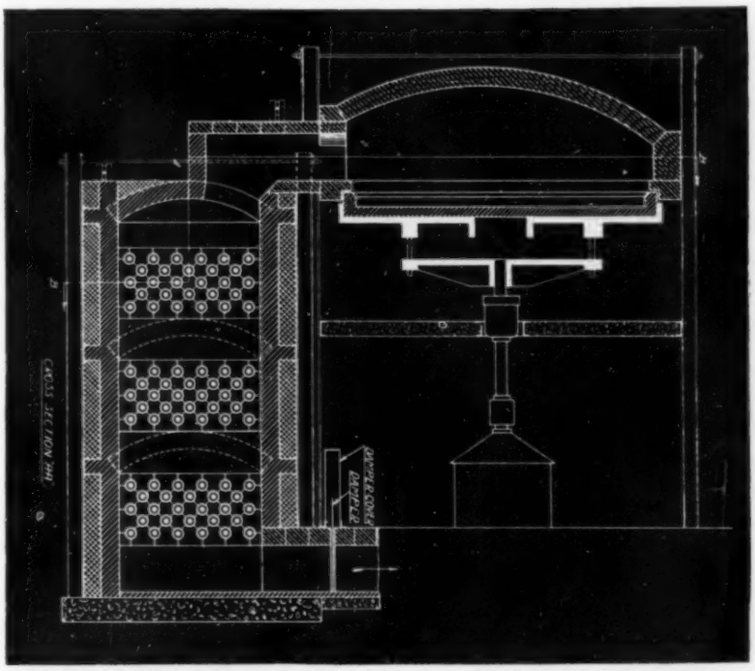
The guarantee was fulfilled with a comfortable margin as fuel consumption on carefully supervised tests dropped to 43,300 cu. ft.

Operating, labor and upkeep costs were cut—and quicker starting—smoother operation—easier control and far less trouble from leakage were the other results from this Carborundum Company recuperator installation.

Each of the three recuperators utilizes banks of tubes made from "Carbofrax"—the "Carborundum" Brand Silicon Carbide Refractory. The tubes are 52 inches long, 7/8 inch thick walls.

The high thermal conductivity of "Carbofrax" and its remarkable refractoriness are responsible for years of operation with no recuperator maintenance charges and the reduction of flue gas temperatures from 1775° F. entering the recuperator to 650° F. at the stack.

The estimated life of the installation is 10 years.



**Carbofrax**
REG. U. S. PAT. OFF.

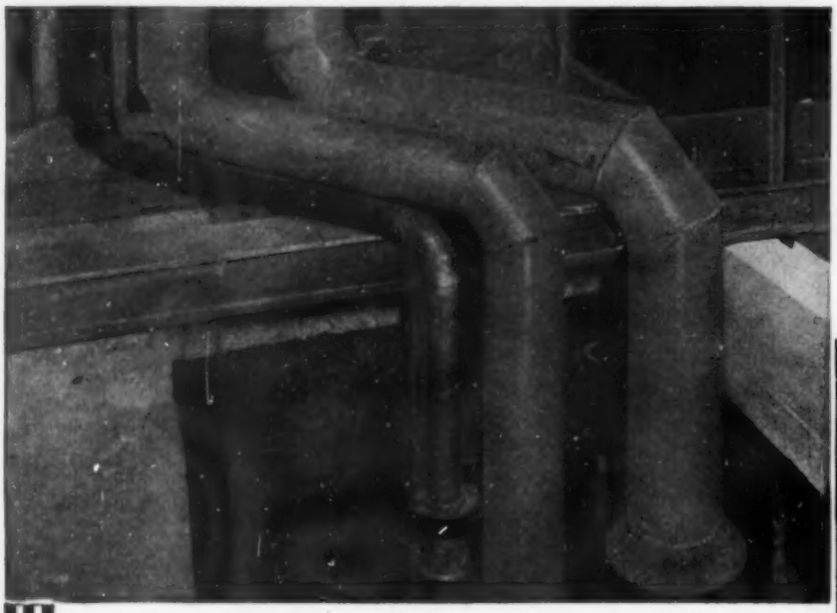
**THE CARBORUNDUM BRAND SILICON CARBIDE REFRACTORY**

*Carborundum Engineers will gladly give you more information*

**THE CARBORUNDUM COMPANY**
REG. U. S. PAT. OFF.

*Perth Amboy, N. J.*

[CARBORUNDUM AND CARBOFRAX ARE REGISTERED TRADE MARKS OF THE CARBORUNDUM COMPANY]



# *Oxwelding*
# REDUCES COSTS

Oxwelding has revolutionized pipe installation practice. It is a new and better method in the hands of the pipe fitter. Oxwelded joints develop the full strength of the pipe itself and consequently lighter-walled pipe can be used for the entire system of piping. Oxwelded joints, once tested and found tight, always remain so, thus eliminating maintenance costs. Costly cast or forged fittings and special bends are also eliminated, except where flanged or screwed couplings are required to connect to valves. The most complicated fittings are neatly and compactly fabricated by oxwelding from standard sizes of pipe.

Welded piping construction may be undertaken with the same confidence in a satisfactory result as older methods and with further assurance of increased economy and serviceability.

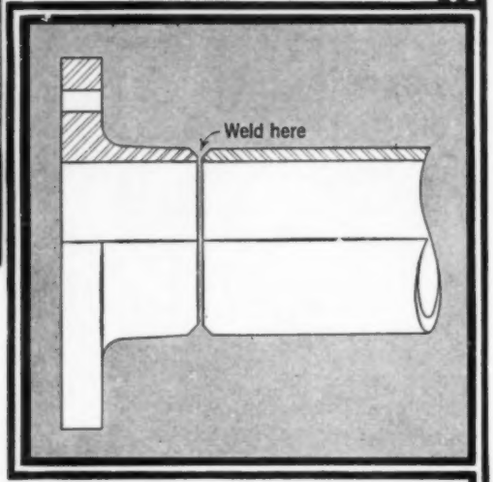
## *DESIGN STANDARDS FOR OXWELDED PIPING*

***Any welded piping system, even in its most complicated form, is a combination of a few fundamental welding design details.***

### PIPE FLANGES
**Standard Flange for Welding**

***Explanation:***

A type of flange especially designed for welded piping construction is illustrated. It is supplied by leading manufacturers of pipe fittings in both forged and cast steel. Either flat or tongue and groove




faces can be obtained to meet service requirements. It is provided with an extra long hub for butt welding into the line.

***Uses:***

The Standard Flange for Welding is recommended to replace by welded construction other types of American Standard flanges for all sizes, pressures and services.

***Specification:***

When the Standard Flange for Welding is specified the following features should be included in the specification:

1. The flange shall be carefully tacked before welding, with tack welds not more than 6 in. apart, to facilitate and maintain alignment.
2. Bolt holes shall straddle natural center lines except when specified otherwise.
3. Other features to be included in the specification are the same as for the Open Single Vee Butt Weld given on page 10, "Design Standards for Oxwelded Piping," except that in all cases the weld shall be built up to a height in excess of the thickness of the welding end of the flange hub.

The above is excerpted from a handbook on fundamental designs, titled, "Design Standards for Oxwelded Steel and Wrought Iron Piping," published by The Linde Air Products Company.

You should have a copy of this handbook. It is yours for the asking.

**THE LINDE AIR PRODUCTS COMPANY**

*Unit of Union Carbide and Carbon Corporation*

126 Producing Plants · UCC · 627 Warehouse Stocks

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# The OPERATION is as SIMPLE as . .

**A** One turn of a pointer and the machine is set for the desired current.

**B** One turn of a wheel and the machine is set for the desired voltage.

**C** That's all. The operator is then free to give his entire time and thought to the work.

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**Combines and excels all the best features of all the good welders now on the market... plus new features all its own.**

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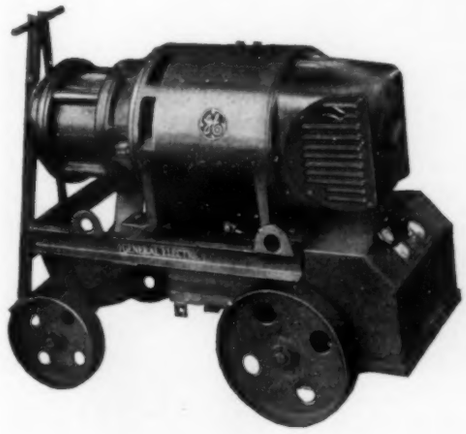
11. A definite purpose for every ounce of material



**"Easy to get the heat you want" says the operator, smiling. And a satisfied operator means better welding.**

**Before buying any arc-welding set, investigate this advanced machine which bears the G-E monogram. Immediate shipment can be made from any of 20 G-E warehouses throughout the country. Ask your nearest G-E office.**

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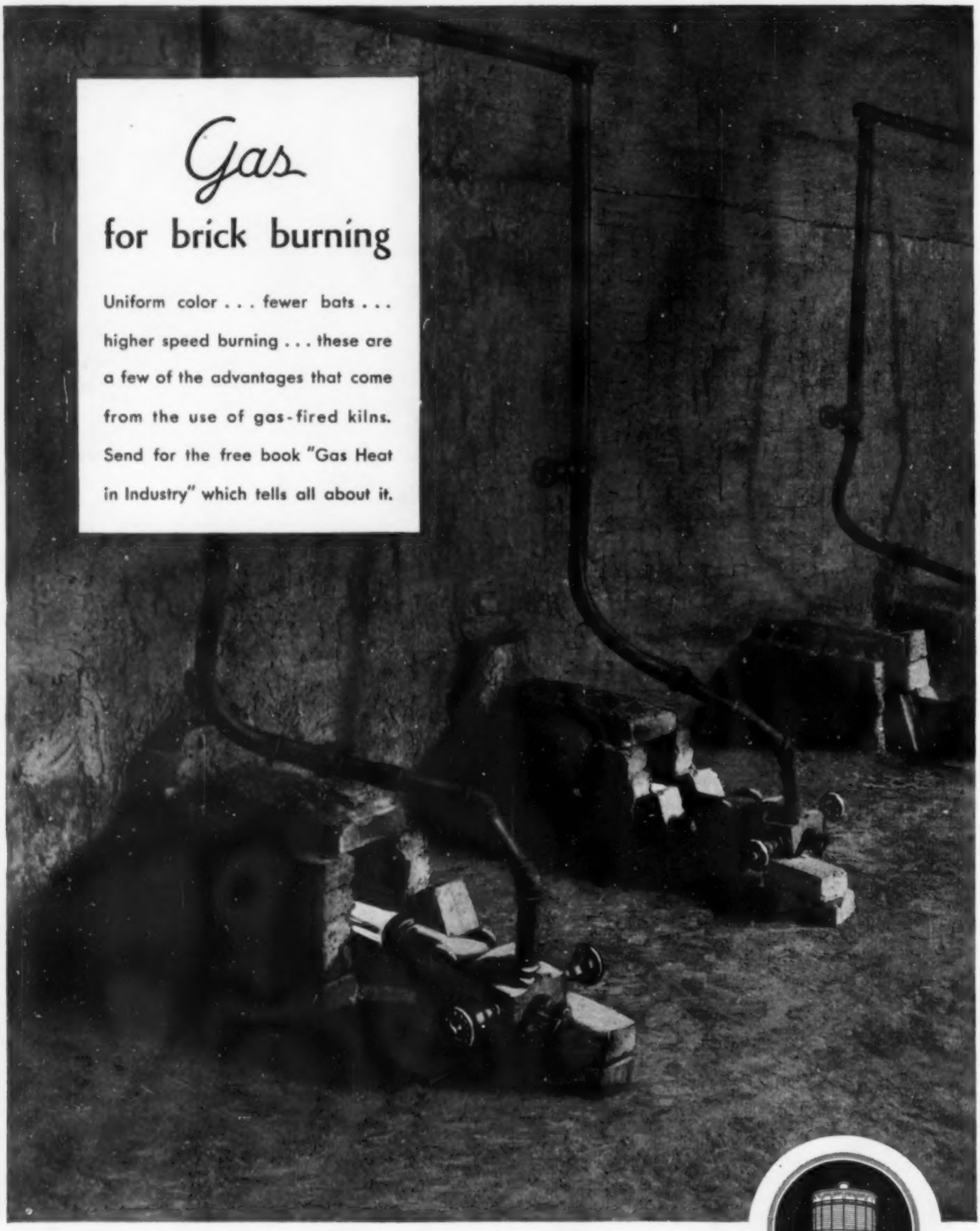
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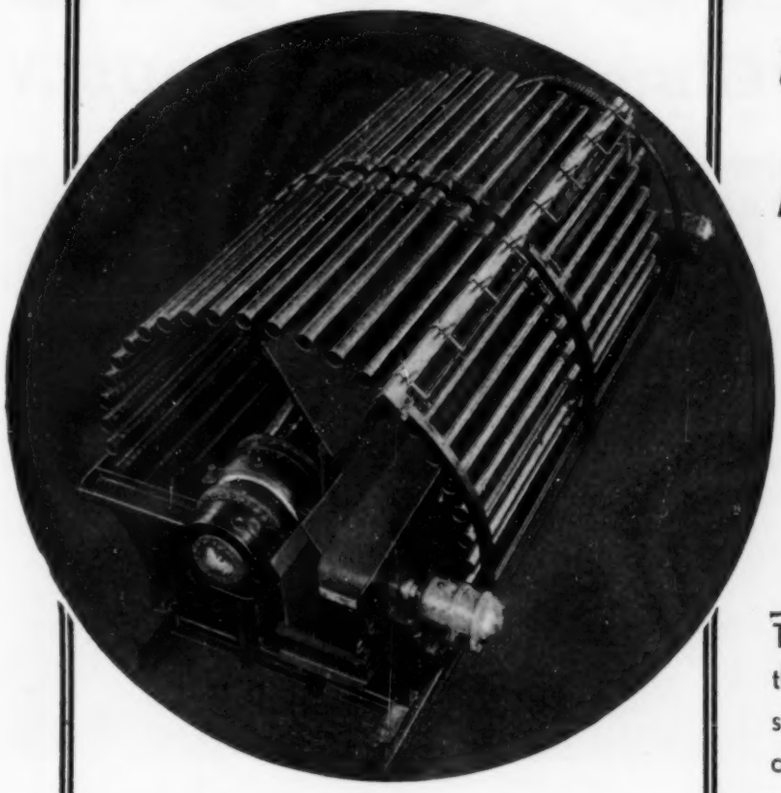
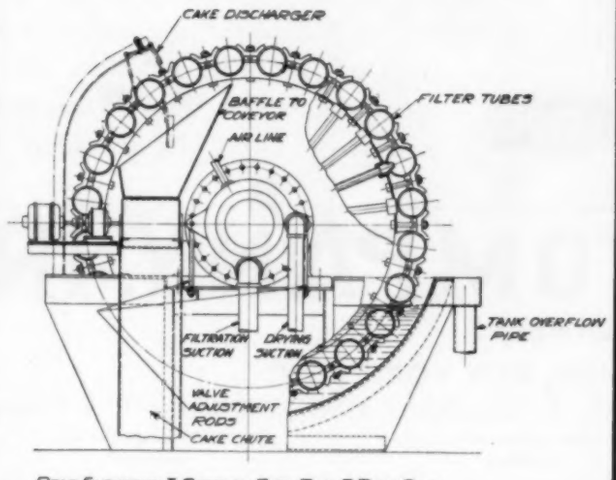
# The Filter that produces a *thoroughly homogeneous cake*



## The B. H. CO. (GENTER TYPE) OSCILLATING CONTINUOUS FILTER

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To secure a thoroughly homogeneous cake it is necessary that the sludge bath be effectively agitated in direct contact with the filtering elements. The B. H. Co. (Genter Type) Filter effects this agitation by dividing the entire filter surface into a number of small units that are oscillated, squirrel-cage fashion, around a central shaft. Not only does this construction provide thorough agitation by the filter units proper, but it results in many other exclusive advantages in capacity and drying properties and in mechanical and operating features.

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**THE BARTLETT HAYWARD COMPANY**
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# CUTTING COSTS

## by Thickening Gluten CONTINUOUSLY

One of two special design Dorr Thickeners used for handling gluten in a middle-western plant. Note the small amount of head-room required by this type of Thickener

Gluten, separated from starch in corn product plants, is a light, flocculent material, difficult to handle. The old method of treating this material consisted of batch settling in settling troughs, followed by intermittent filtration on presses.

Now thickening and filtration of gluten can be carried out continuously. Assisted by the cooperation of prominent corn product manufacturers, Dorr engineers made a long series of tests in the laboratory and in commercial plants. The result was the development of a special design Dorr Thickener which thickens the gluten continuously and discharges it at a consistency which is suitable for continuous filtration on Dorrco or Oliver United filters. In the plant illustrated, two Dorr Thickeners and a Dorrco Filter have replaced batch equipment for handling gluten. Operation is smoother, costs have come down.

Your own plant operations may be quite different from those of corn product plants. But if your process involves any operation of thickening and dewatering, any step tied in with wet-material handling and treatment, we believe that we can show you that it pays to "Use the Dorr Way."

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**ENGINEERS**

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ROASTING (REDUCING) oxidized ores or materials.
ROASTING (DECOMPOSING) ores or mixtures.
ROASTING (VOLATILIZING) ores for recovery of readily volatile contsituents.
ROASTING (CHLORIDIZING, ETC.) ores with admixture of chemical agents.

IT WILL PAY YOU TO INVESTIGATE

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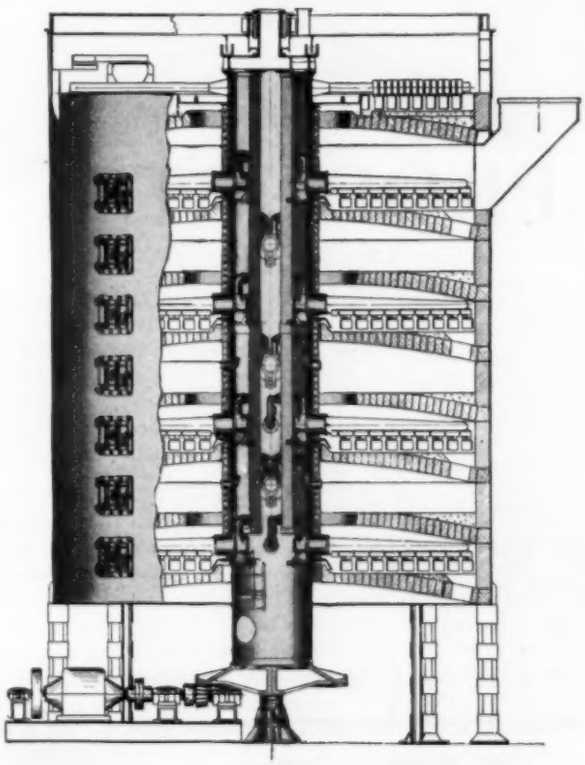
(Patented)



THE multiple-hearth mechanical furnace is constantly being applied to various heat-treating operations which were formerly performed in less efficient types of burners or furnaces. The efficiency and economy of the multiple hearth type is due to its greater adaptability to diverse operating conditions; it is mechanical and it is continuous in operation.

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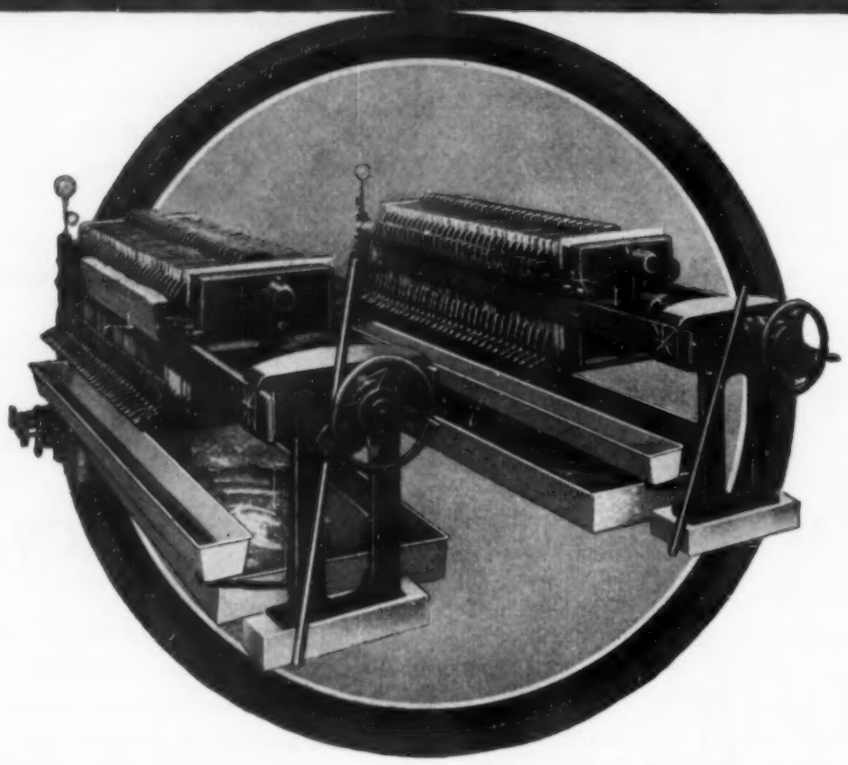

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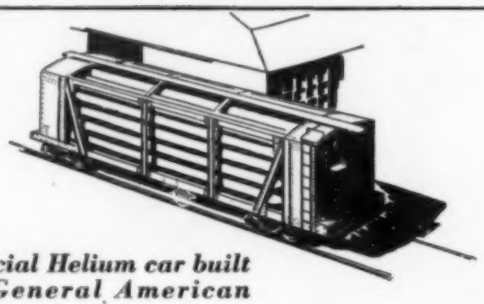

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**A railroad car can be built to carry anything in bulk. These are but six of thousands of products now being shipped this modern efficient way.*

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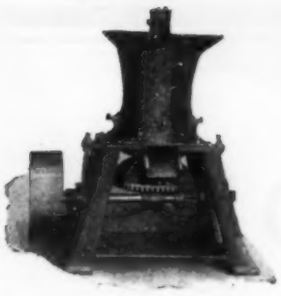

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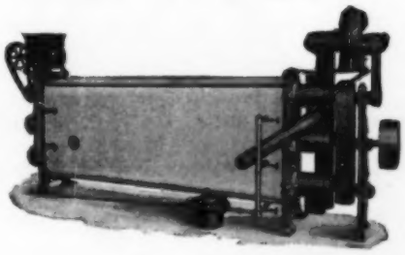
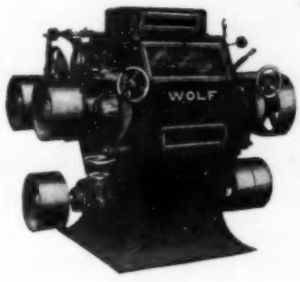
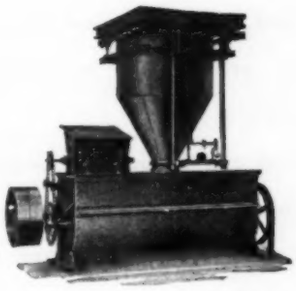


DRYERS




GRINDERS



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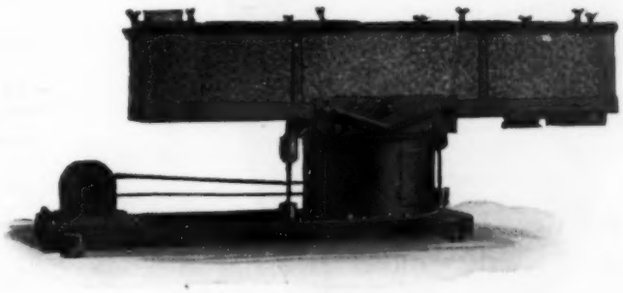

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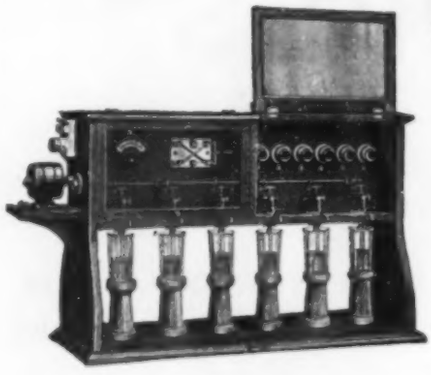

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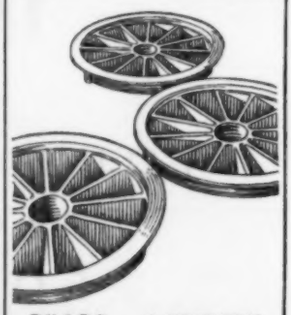

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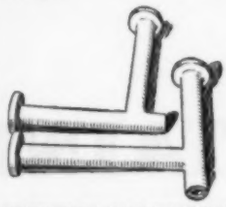

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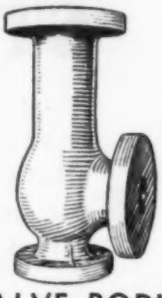

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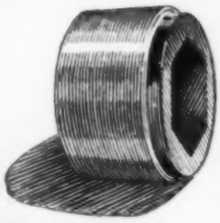

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# Hybnickel

Heat and Acid Resisting
Castings and Forgings

*The Right Alloy in the Right Place*

*Special Alloys for Special Purposes*

*Address all Inquiries to*

**HYBNICKEL ALLOYS CO.**

Care of THE PUSEY AND JONES CORPORATION, Front and Poplar Sts.
WILMINGTON, DELAWARE

# A LIBERTY JOB IN SILVER

Typical of Liberty craftsmanship, this evaporator was recently installed in the plant of one of the larger chemical companies. It is of pure silver with silver valves and sampling device. Mounted in copper jacket.

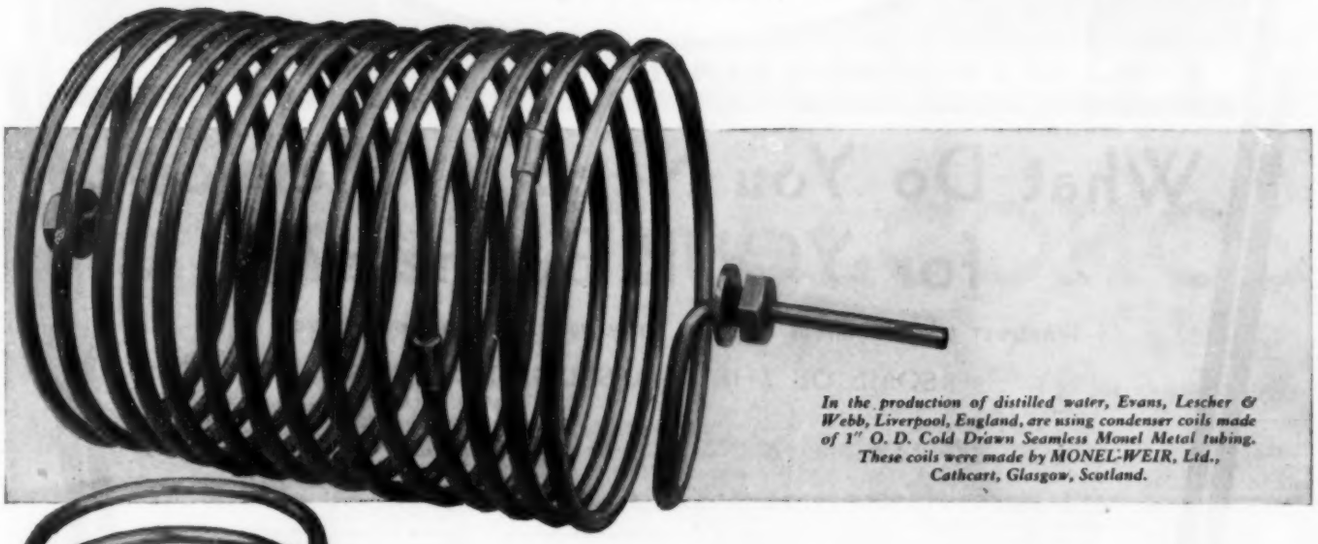
*For the usual or unusual job in any metal—Let Liberty do it! Prompt, economical, quality work.*

**LIBERTY COPPERSMITHING COMPANY**
1708 N. Howard St., Philadelphia, Pa.

# Now Available . . .

## COLD DRAWN

# MONEL METAL SEAMLESS TUBING



*In the production of distilled water, Evans, Lescher & Webb, Liverpool, England, are using condenser coils made of 1" O. D. Cold Drawn Seamless Monel Metal tubing. These coils were made by MONEL-WEIR, Ltd., Cathcart, Glasgow, Scotland.*

HERE'S news the chemical and process industries will welcome: *Seamless* Monel Metal tubing is now available! Now you can specify seamless Monel Metal tubing tested to 700 lbs. per square inch, suitable for heaters, coils and other equipment... and get what you want.

Now you can get Monel Metal tubing that offers ductility combined with integral, uniform structure and consequent higher resistance to many acid and alkaline solutions.

Monel Metal seamless tubing derives its basic advantages from the rare combination of properties that have made this solid Nickel alloy indispensable for numerous processing applications. Monel Metal is rust-proof and highly resistant to the corrosive attacks of many chemical agents including dilute sulphuric acid, ammonia and brines. It has no coating to chip, crack or wear off, and its steel-like strength is a bulwark against premature breakage and rapid depreciation. These advantages, plus its seamless construction, make this Monel Metal tubing definitely superior to welded tubing for many essential types of equipment.

Monel Metal seamless tubing has been thoroughly tested and proved in laboratory and plant. We will gladly send you further information about the advantages and uses of this new product, including price schedule and mill limits.

*One of four large Monel Metal gas coolers used in connection with ammonia synthesis at the plant of a large British chemical manufacturer. 665—1" O. D. 18 gauge, 13' 2⅝" long, seamless Monel Metal tubes are expanded into 65⅜" diameter, 1¼" thick Monel Metal tube plates. These coolers were manufactured by Daniel Adamson & Co., Ltd., Dukinfield.*

**THE INTERNATIONAL NICKEL COMPANY, INC.**
**67 Wall Street** **New York, N. Y.**

/A HIGH NICKEL ALLOY

**MONEL METAL**

NICKEL ALLOYS PERFORM BETTER LONGER

Monel Metal is a registered trade mark applied to a technically controlled nickel-copper alloy of high nickel content. Monel Metal is mined, smelted, refined, rolled and marketed solely by International Nickel.

INDUSTRY'S RAW MATERIALS

FOUNDED 1839

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REG. U.S. PAT. OFF.

*The* BEST-KNOWN QUALITY MARK *in* CHEMICALS

## What Do You Need in Chemicals for YOUR Business?

***Whatever your requirements, just write, wire or phone our nearest office***

### SOME OF THE GRASSELLI PRODUCTS

Acetate of Lead
Acetic Acid Commercial
Acetic Acid Glacial
Acetic Acid Pure
Acetic Acid Redistilled
Alum—Ammonia U.S.P.
Alum—Filter
Alum—Paper Makers
Alum—Pearl
Alum—Potash U.S.P.
Aluminum Sulphate Commercial and Iron Free
Aluminum Chloride Crystals
Aluminum Chloride Solution
Aqua Ammonia
Aqua Fortis
Arsenate of Lead Paste
Arsenate of Lead Powder
Arsenic Acid
Barium Carbonate
Barium Chloride
Barium Sulphate—(Blanc Fixe)
Battery Coppers
Battery Zinc
Bi-Sulphate of Soda
Bi-Sulphite of Soda Solution
Bordeaux Mixture Powder
C. P. Ammonium Hydroxide
C. P. Hydrochloric Acid
C. P. Nitric Acid
C. P. Sulphuric Acid
Cadalyte
Cadmium
Cadmium Anodes
Cadmium Hydrate
Cadmium Sulphide
Calcium Arsenate Powder
Casein Spreader
Chromic Acid
Depilatory
Dust Mixtures
Duclean—Iron drum cleaning compound
Dutox—a Non-arsenical Insecticide
Electrolyte
Formic Acid
G. B. S. Soda
Glauber's Salt
Glauber's Salt Anhydrous
Hypo-sulphite of Soda Crystals
Hypo-sulphite of Soda Granulated
Hypo-sulphite of Soda Pea Crystals
Indium—metal or oxide
Inhibitor No. 1—Non-Foaming
Inhibitor No. 2—Foaming
Intermediate Zinc
Lactic Acid
Lime Sulphur Solution
Manganar Dust—for roses
Mixed Acid
Mossy Zinc
Muriate of Tin Crystals
Muriate of Tin Solution
Muriatic Acid
Nitric Acid Commercial
Nitric Acid Fuming
Nogas
Oleum
Phosphate of Soda
Phosphate of Soda—Anhydrous
Phosphate of Soda—Mono (Sodium Phosphate Mono Basic)
Sal Ammoniac
Salt Cake
Sherardizing Zinc
Silicate of Soda Granulated
Silicate of Soda Lump
Silicate of Soda Meta
Silicate of Soda Pulverized
Silicate of Soda Solid Glass
Silicate of Soda Solution
Snowflake Soldering Salts
Sodium Silico Fluoride
Soldering Flux Crystals
Soldering Flux Solution
Slab Zinc
Strontium Nitrate
Sulphate of Soda Anhydrous
Sulphate of Soda Technical
Sulphate of Zinc
Sulphide of Soda Concentrated
Sulphide of Soda Crystals
Sulphide of Soda Flake
Sulphide of Soda Fused Solid
Sulphite of Soda Crystal
Sulphuric Acid
Summer Fruit Spray
Super-Phosphate
Super Sulphate of Soda
Tin Crystals
Tinning Flux
Tri-Sodium Phosphate
Zinc Anodes
Zinc Chloride Fused
Zinc Chloride Granulated
Zinc Chloride Solution

*Our Research Department may be of help in solving some of your problems. This service is available to you*

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Incorporated — Cleveland

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*A Standard Held High for 92 Years*

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SYNTHETIC

NORMAL **BUTYL ACETATE**

NORMAL **BUTYL ALCOHOL**

▪ These important industrial solvents, produced for the first time in the United States by synthetic processes, are now available in drum lots and tank car quantities. ▪ The user of these synthetic compounds, manufactured under closely controlled processes and synthesized from raw materials not subject to periodic price fluctuation, is assured of uniform quality and price stability. ▪ The commercial availability of BUTYRALDEHYDE and CROTONALDEHYDE is also announced. ▪ We will be glad to send you samples and detailed information regarding these products or other products of our manufacture upon request.

**CARBIDE AND CARBON CHEMICALS CORPORATION**

PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

**PRODUCTS MANUFACTURED BY CARBIDE AND CARBON CHEMICALS CORPORATION**

ACETONE
BUTYL ACETATE
BUTYL ALCOHOL
BUTYL CARBITOL ★
BUTYL CELLOSOLVE ★
BUTYRALDEHYDE
CARBITOL ★
CARBOXIDE ★
CELLOSOLVE ★
CELLOSOLVE ★ ACETATE
CROTONALDEHYDE
DICHLORETHYL ETHER
DIETHYLENE GLYCOL
DIOXAN
ETHYLENE DICHLORIDE
ETHYLENE GLYCOL
ETHYLENE OXIDE
ISOPROPANOL
ISOPROPYL ETHER
METHYL CELLOSOLVE ★
METHANOL
PROPYLENE CHLORHYDRIN
PROPYLENE DICHLORIDE
PROPYLENE GLYCOL
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TRIETHYLENE GLYCOL
VINYL CHLORIDE
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ETHANE
ISOBUTANE
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**30 East 42nd Street, New York**

**230 North Michigan Avenue, Chicago**

*Unit of Union Carbide* UCC *and Carbon Corporation*

*Technical Division* CE-12-31

CARBIDE AND CARBON CHEMICALS CORPORATION
New York, N. Y.

Please send me further information about your synthetic Butyl Alcohol ☐ Butyl Acetate ☐ Butyraldehyde ☐ Crotonaldehyde ☐

*Name*_____

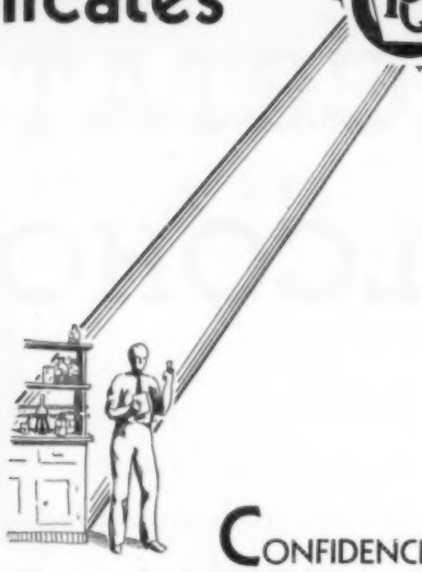
*Company*_____

*Street*_____

*City*_____ *State*_____

# Forward with P. Q. Silicates

1831 PQ 1931



CONFIDENCE in your source of supply relieves you of many worries. The certainty that . . .

. . . P. Q. Silicates will meet your requirements today, tomorrow and always —

. . . deliveries can be made promptly from the nearest of eight plants located to best serve your industry —

. . . if you have a problem involving silicate, an experienced technical department intelligently studies it and usually knows the answer —

. . . develops a sense of reliability that is priceless to the forward looking manufacturer.

Right now is an opportune time to become acquainted with P. Q. Silicates and P. Q. Service. May we have the pleasure of talking it over with you?

PHILADELPHIA QUARTZ CO.

*General Offices and Laboratory*
121 S. THIRD STREET
PHILADELPHIA
*Chicago Office*
205 W. WACKER DRIVE
1831-1931
*Beginning Another Century*

# Make Certain of A Quality Blue Before you "Strike"

Many of the characteristics of the finished "blue" are determined by the uniformity of the raw materials from batch to batch.

Recognizing this fact, we keep Aero Brand Yellow Prussiates of Soda and Potash uniform by a "master-batch" system of production control.

Such careful and expensive control is possible only when the manufacturer can start with basic materials and produce continuously on a volume basis.

Get the advantages of uniformity and large-scale production by specifying Aero Brand Yellow Prussiate of Soda and Potash.

*Industrial Chemicals Division*
American Cyanamid Company
*535 Fifth Avenue New York*

# A NEW TYPE OF NITROCELLULOSE COATING

**Nitrocellulose coatings having all the desirable brushing qualities of oleo-resinous finishes plus the durability and cleanability of lacquer, are now made possible by the use of BUTYL LACTATE.**

**Send for a sample of this new and useful solvent.**

## COMMERCIAL SOLVENTS CORP.

**PLANTS: Terre Haute, Ind., and Peoria, Ill.**

**Sales Offices: New York Central Bldg., 230 Park Ave., New York, N. Y.**
**Terre Haute, Ind. Aldwych House, Aldwych, W. C. 2, London, Eng.**

# SULPHUR
(99½%)

EVERY day we mine 4000 to 5000 gross tons. Your business is solicited whether of carload or cargo quantities.

TEXAS GULF SULPHUR CO.
75 E. 45th Street New York City
Mines: Gulf, Newgulf and Long Point, Texas

***IMPURITIES COST MONEY!***

•

**Impurities cause rejections, spoilage, dissatisfaction, loss of profits.**

**When chemical or mechanical methods fail to eliminate them from your process liquids try DARCO.**

**DARCO purifies, clarifies, decolorizes — economically, effectively, efficiently.**

**Write for Free Sample**

*This trade-mark* DARCO *On every carton*

**"IT GOES FURTHER"**

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**DARCO SALES CORPORATION**
**45 East 42nd Street**
**New York, N. Y.**

Telephone: Vanderbilt 3-1592
Cable Address: DARCOSALE, New York

# Standard Bleaching Powder

Liquid Chlorine

*Single Unit Tank Cars* *Multi-Unit Tank Cars (1-ton Containers)*

*150-lb. Cylinders*

Natrona Porous Alum
Commercial Alum

PENNSYLVANIA SALT MANUFACTURING COMPANY

*Executive Offices:*
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*Representatives:*
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*Works:*
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Tacoma, Washington

The Wooden Barrel will "give" slightly against a crushing blow, but spring back once the pressure is released.

# STRENGTH

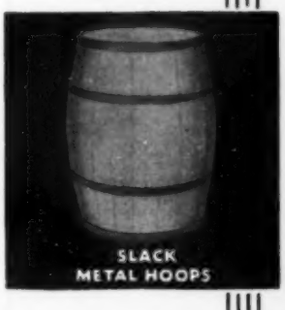
In the engineering fraternity the dome is recognized as a structure of exceptional strength.

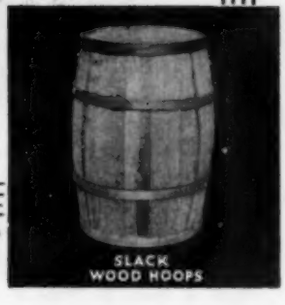
The structural characteristics of a barrel are strikingly similar to the dome. A force applied at any one point on the barrel is distributed over the entire structure. This feature of barrel design gives remarkable superiority in strength.

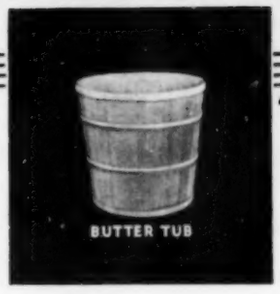
Also the wooden barrel is resilient to shocks, and can withstand enormous external pressures and crushing impacts without damage. It brings you the ultimate in protection for your product.

Wet or dry, light or heavy, your product can be shipped economically in barrels. The Associated Cooperage Industries of America can advise you as to the type best suited for your purpose. Send for the Wooden Barrel Booklet.

# WOODEN BARRELS





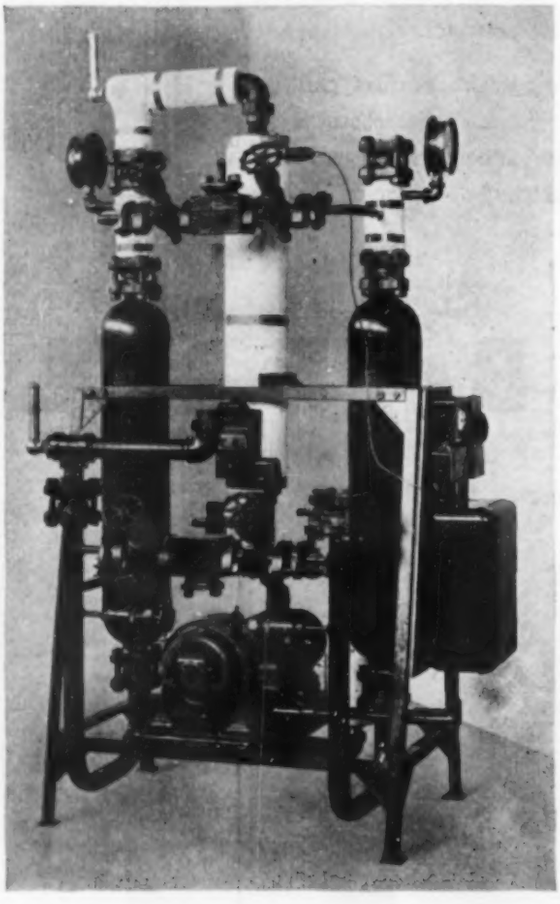




THE ASSOCIATED COOPERAGE INDUSTRIES OF AMERICA

RAILWAY EXCHANGE BUILDING
ST. LOUIS MISSOURI

# Purifying and Dehydrating $CO_2$ —*at one operation*

**THE Silica Gel unit shown here is the high pressure type used principally in plants which produce liquid carbon dioxide for beverage purposes.**



*The Silica Gel unit illustrated is seven feet high and requires a floor space only 4 by 3 feet. It has a capacity of 500 pounds of $CO_2$ per hour.*

**It is used after the third stage of compression; and in one operation completely removes odors, oil of compression and other impurities. In the manufacture of solidified $CO_2$ (dry ice) no freezing difficulties are encountered when operating at temperatures well below minus 40° F.**

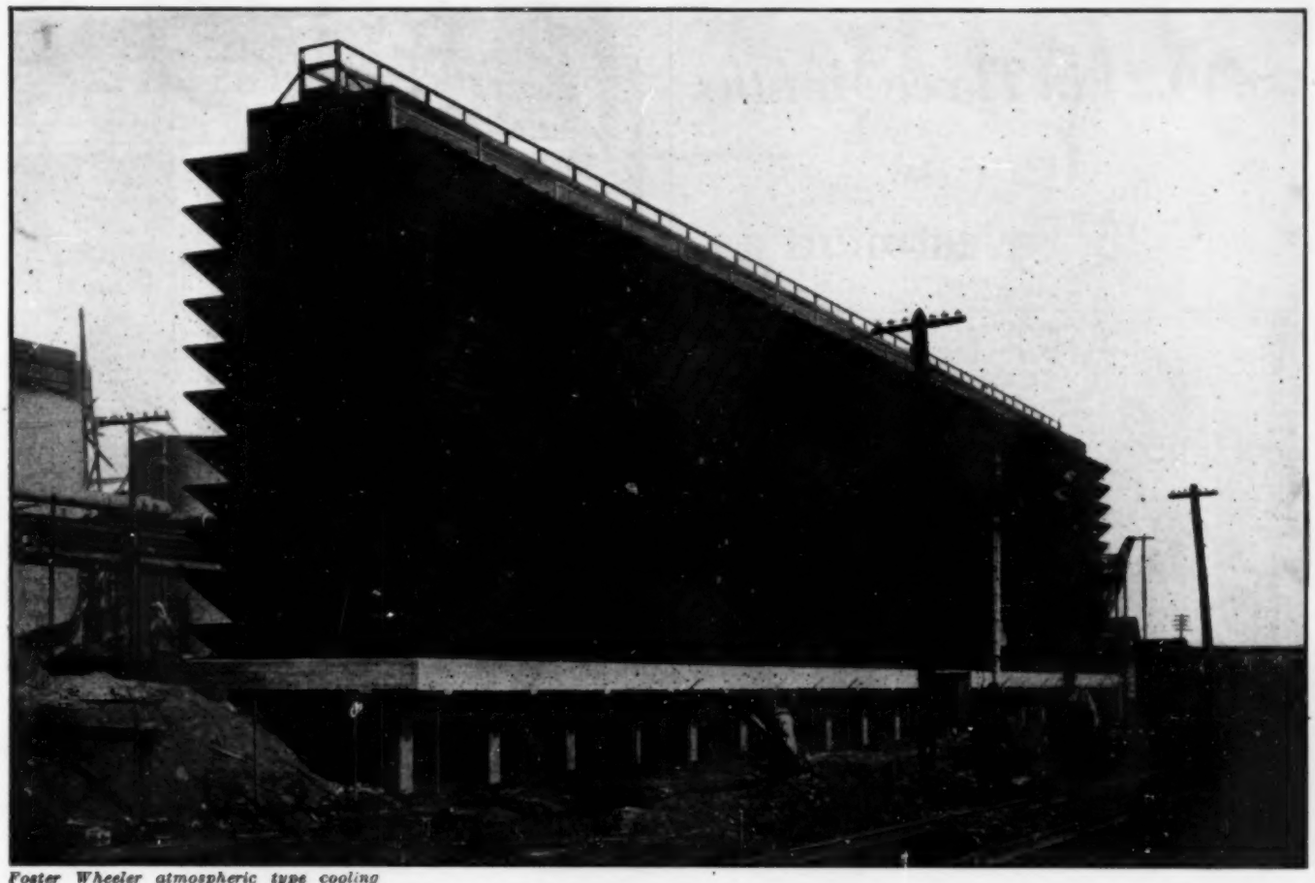
**Regardless of the source of your gas, or the system of compression used, there is a standardized Silica Gel unit to meet your requirements.**

**Our competent and experienced engineering staff is at your service to recommend the equipment most suitable to your own operating conditions.**

*Write for full Details*

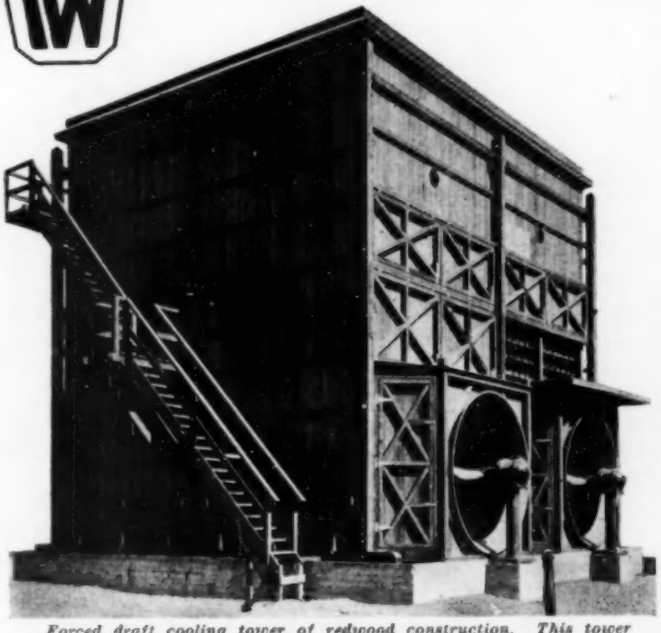
## THE SILICA GEL CORPORATION

BALTIMORE TRUST BUILDING BALTIMORE, MARYLAND



*Foster Wheeler atmospheric type cooling tower constructed entirely of California redwood. It has a capacity to handle 3,500 gallons of water per minute.*

# Cooling Towers for All Purposes



*Forced draft cooling tower of redwood construction. This tower is designed with removable type filling which may be taken out for cleaning through either tier of doors shown above the airplane type fans.*

The design and manufacture of atmospheric, natural draft, induced draft, forced draft, and combination forced and natural draft towers places Foster Wheeler in a position to supply a suitable tower for any cooling requirement.

The towers are furnished in standard unit sections. Large capacities or increased requirements of existing towers may be met by the installation of additional sections. Wood, metal and concrete shells are supplied.

Forced and natural draft cooling towers are built with the filling entirely separate from the shell. This construction assures a tower that remains tight, since strains set up as the filling becomes alternately wet or dry, are not transmitted to the shell.

**FOSTER WHEELER CORPORATION**
**165 Broadway, New York, N. Y.**
***Branches in Principal Cities***

# FOSTER WHEELER

# $349.21 *in Three Months* from a $525 Investment

SOUTH WEST BOX COMPANY
SAND SPRINGS, OKLAHOMA

MOREHEAD MANUFACTURING COMPANY,
4895 GRAND RIVER AVE.,
DETROIT, MICHIGAN.

| DATE OF INVOICES | AMOUNT OF INVOICES | DEDUCTIONS | | |
|---|---|---|---|---|
| | | FREIGHT | SUNDRY | MEMORANDUM |
| 8/7 | 117.05 | | | Savings made in fuel bill for month of July, 1931 |

| TOTAL OF INVOICES LESS DEDUCTIONS | CASH DISCOUNT | AMOUNT REMITTANCE |
|---|---|---|
| $ 117.05 | $ | $ 117.05 |

To drain their steam-heated equipment and return condensate to the boiler, South West Box Company, Sand Springs, Oklahoma, last June bought a Morehead-Back-to-Boiler System—for $525.00.

The above remittance memo shows that in July, $117.05 in fuel alone was saved as a result of this Morehead installation.

Fuel saving in August was $101.65—in September $130.51.

With Morehead equipment, you can make important savings in your own plant.

Get the facts. Send for our interesting 44-page booklet.

MOREHEAD MANUFACTURING COMPANY
DEPARTMENT CM - DETROIT, MICHIGAN

**Morehead**
**Back to Boiler**
**SYSTEM**

COUPON

Morehead Mfg. Co.,
Department CM,
Detroit, Michigan

I'd like to have your interesting 44-page booklet, giving helpful information regarding the Morehead Back-to-Boiler System. This will, of course, place me under no obligation.

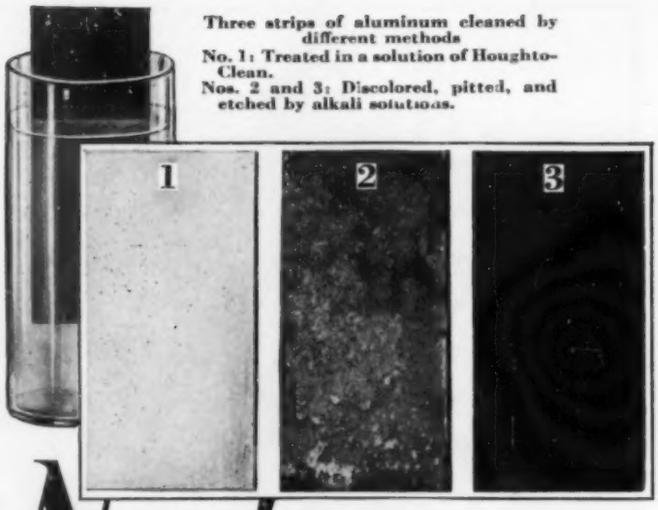
Name_____

Company_____

Address_____

City_____ State_____

(489)




Three strips of aluminum cleaned by different methods
No. 1: Treated in a solution of Houghto-Clean.
Nos. 2 and 3: Discolored, pitted, and etched by alkali solutions.

# *Now!* you can clean ALUMINUM *without Discoloration or Loss of Weight*

Ask your nearest Houghton Man to demonstrate the NEWEST method of cleaning aluminum.

A special grade of Houghto-Clean has been developed for this work by the Houghton Research Staff. It is far less costly than volatile cleaners, and has none of the destructive effects of alkali solutions. Regardless of temperature, concentration of solution, or time of immersion, it will not discolor the metal nor eat into the surface.

Recently, a leading manufacturer of aluminum ware decided to run his own tests on Houghto-Clean. Using the dirtiest, greasiest aluminum available, he suspended a dozen strips in various Houghto-Clean solutions. After 5 hours, the specimens were inspected thoroughly. Not only were they clean, but the loss of weight was infinitesimal—ranging from 2 to 15 ten-thousandths of a gram.

In contrast, note the results with two competitive cleaners. The photographs (unretouched) show clearly the dangerous effects of alkali solutions on aluminum.

# E. F. HOUGHTON & CO.

PHILADELPHIA - CHICAGO - DETROIT
*And All Over the World*

# A PARADE *of* STEAM TRAPS — *20 years long!*

## *Since 1911*

an endless parade of Armstrong Inverted-Bucket Traps has been moving out of Three Rivers, Michigan, and terminating at plants in the chemical and other steam using industries. The size of this parade has been steadily increasing; now there are more Armstrongs in use than any other mechanically operated trap. Many companies have more than a thousand each; a large number have over a hundred each; many nationally known concerns have standardized on them.

Why this faith in Armstrong traps, that impels original buyers to reorder time and again? It is simply the natural result of *outstanding performance*—a demonstrated ability to deliver the most value for the money.

The Armstrong reputation for steam trap satisfaction is not based on merely one or two features. The Armstrong trap has every desirable feature, such as: impossibility of air-binding . . . no clogging on scum or sediment . . . small size with large capacity . . . elimination of wire-drawing and valve scoring . . . practically attentionless operation . . . negligible repair cost.

A nation-wide service organization backs up our guarantee of complete trapping satisfaction. Stocks in all principal cities.

Armstrong traps are, of course, not limited to use on steam. They are also used to separate gas and liquid at pressures of 1500 lbs. and over.

We'll be glad to send you as many traps as desired, for 90 days' free trial. After the test, return the traps collect. Write us, giving pressures, service, pipe sizes, etc.

**New No. 100 Trap**

***Big Capacity in small size.***

***Straight-through connections.***

**No fixed pivot or wearing parts.**
***Ask for New Bulletin.***

**ARMSTRONG MACHINE WORKS**
**858 Maple Street, Three Rivers, Mich.**
***Stocks in all principal cities***

CME12Gray

# *New* direct reading ILLUMINOMETER

**Now—no more guess-work in illumination surveys. The new Weston ILLUMINOMETER reads Foot-Candles directly, accurately, easily. Human error is eliminated—no adjustments . . . no allowances. Extremely flexible — quick, reliable, highly accurate analysis of illumination . . . measurement of reflection and absorption of surfaces.**

**Simple, rugged, compact, the Weston ILLUMINOMETER, Model 603, consists of only two units: Searching Unit of PHOTRONIC CELLS and an indicating instrument calibrated in Foot-Candles. No batteries . . . no lamps . . . no accessories. Nothing to wear out or replace. Easy to use as a voltmeter.**

**Made possible by the new Weston PHOTRONIC CELL, the new Weston ILLUMINOMETER brings ease, simplicity and authority to illumination surveys. Another Weston contribution to the advancement of the science of light.**

***Detailed Information, Circular A-1***

# WESTON

## ELECTRICAL INSTRUMENT CORPORATION

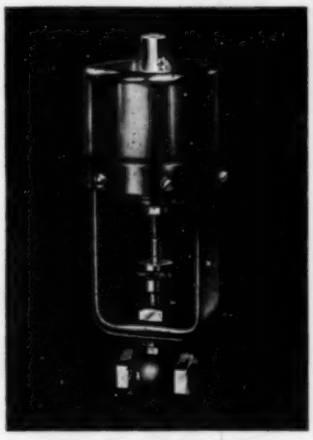
**590 FRELINGHUYSEN AVENUE** **NEWARK, N. J.**

# NEW COMPACTNESS!

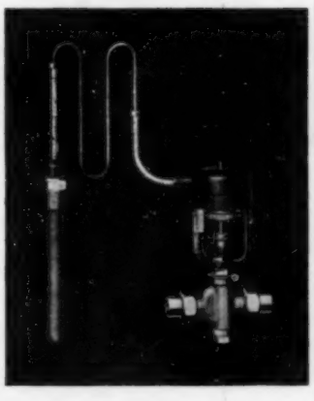
## *Sylphon Temperature and Pressure Regulators of Minimum Space Requirements*

**That should interest you. If you are a user of such equipment as small sterilizers, autoclaves and other apparatus where control of temperature or pressure must be accurately maintained, you will welcome the step this company has taken in designing their well-known regulators in more compact and smaller units for just such purposes.**

**The temperature regulators, designated No. 921, are extremely neat and compact, easily adjusted for temperature within their range and can be installed in any position. They can be furnished finished in nickel or black japan. Operation is not affected by temperature fluctuations at the valve end either above or below the bulb temperature. Excessive temperature rise at the bulb of 100 or 200 degrees will cause no damage. Write for Bulletin XB-125 for further description.**



**The pressure regulators, type 252, are small, well-built units for use on apparatus where pressure control must be accurate and space is at a premium. These, as do the temperature regulators, possess the supersensitive Sylphon Bellows as their expansion member. Adjustment is readily made for different pressures within their range. Once adjusted no further attention is needed. They are built either entirely of brass with nickel finish or with an iron frame with black japan finish. Bulletin XB-225 describes these regulators in detail — write for a copy.**

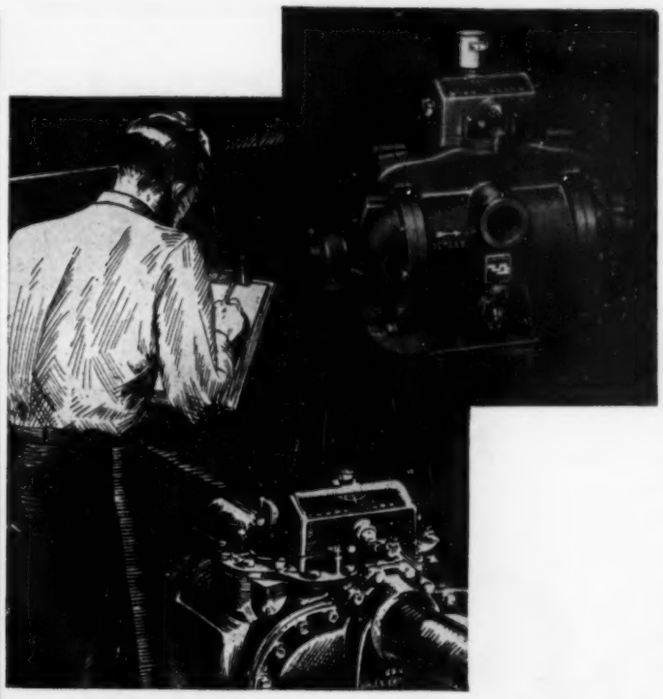


FULTON *Sylphon* FOR TEMPERATURE CONTROL

**FULTON SYLPHON CO.**
KNOXVILLE TENN., U.S.A.

European Representatives, Crosby Valve and Eng. Co., Ltd., 41-2 Foley St., London, W. I., Eng.; Canadian Representatives, Darling Bros., Ltd., 140 Prince St., Montreal, Quebec, Canada

*Representatives in All Principal Cities in U. S. A.*



## MODERN WAY TO MEASURE ALL FLOWING LIQUIDS ACCURATELY

Brodie Universal Meters save time and money and avoid waste in every industry where flowing liquids are handled. No interference to normal liquid flow. Will operate on extremely low pressure heads, depending on viscosity of liquid being measured. All-metal construction assures maintained accuracy on installations where ordinary continuous measuring devices have proven uncertain. By-pass not used,—all liquid is measured volumetrically. Made in all capacities from a fraction of one gallon per hour to 60,000 gallons per hour . . . Non-corrosive construction to suit chemical conditions. Send for your copy of Catalog 121 today!

RALPH N. BRODIE CO.
948 - 61st ST., OAKLAND, CALIF., U. S. A.
CABLE ADDRESS "BRODICO"

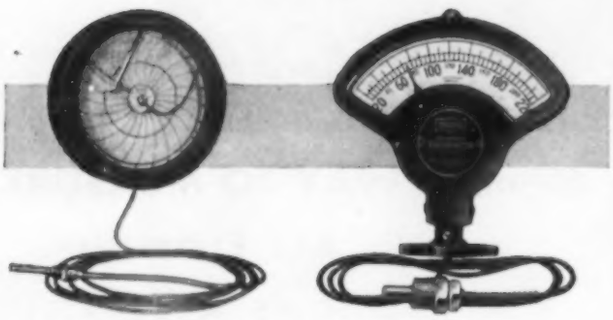
ACCURATE

# BRODIE *Universal* METERS

# WORTHY OF THEIR HIRE

•

## *Wherever accurate temperature is needed*



*Recording Thermometer Model "1000"*

*Standard Type Industrial Thermometer*

MOTOCO INDUSTRIAL THERMOMETERS are indeed worthy of their hire. Available at a moderate price, they quickly pay for themselves in time saved, in waste eliminated and in equipment protected.

Simple in design, yet exceptionally sturdy and accurate, Motoco Thermometers may be relied on for long, dependable service. Either the indicating dial or the recording type is available—the dial type with a large face easily readable at a distance of twenty feet.

Our representative will be glad to call at your convenience for a discussion of your temperature control problems. There is no obligation on your part, of course.

• • •

*The Moto Meter line includes both vacuum and pressure gauges in various types and to fit a wide variety of uses.*

## MOTO METER

GAUGE & EQUIPMENT CORPORATION

TOLEDO, OHIO

Plants at TOLEDO, OHIO; LA CROSSE, WISCONSIN; in CANADA, AUSTRALIA, ENGLAND, FRANCE and GERMANY

For Accurate Control of Low Pressure Air

*Use the*

## ROCKWELL

### Air-Tight Blast Gate

Combines the full pipe area delivery of a gate valve with the quick action of a stop-cock.

Furnished with either threaded or flanged connections for use on standard wrought iron piping, spiral riveted or ordinary sheet steel piping.

Enables a substantial saving in installation costs.

Prevents escape of air, waste of power, loss of money.

Is strong, light and air-tight.

Gives more perfect control than any other blast gate.

The blade stays put.

Write for copy of Bulletin 303E, giving more details regarding this blast gate.

***We also design and build modern industrial heat-treating furnaces.***

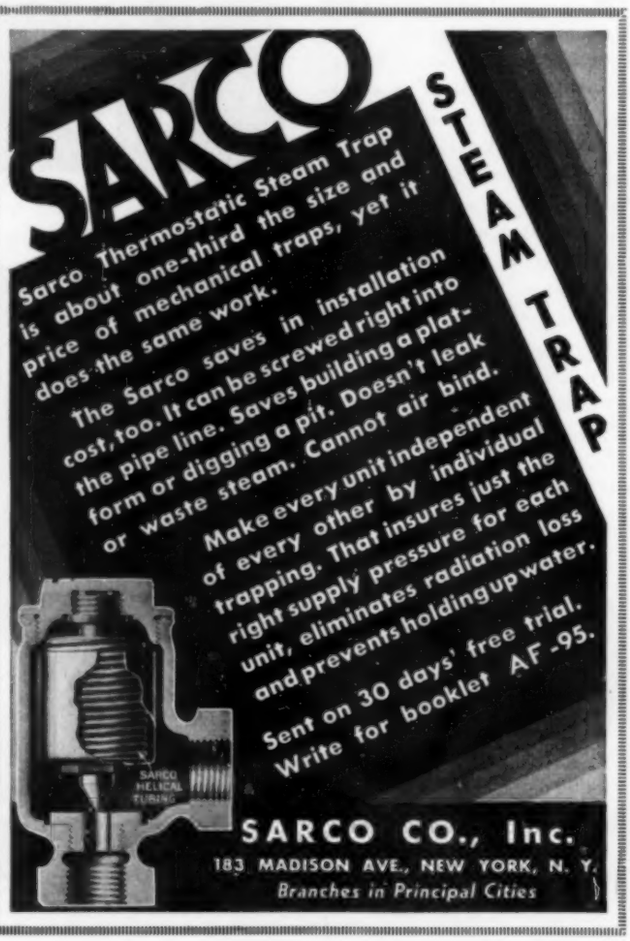
W. S. ROCKWELL COMPANY

*Industrial Heating Equipment*

50 Church St. (Hudson Terminal Bldg.) New York

Detroit Indianapolis Cleveland Montreal, 930 Wellington St. Chicago




SARCO
STEAM TRAP
Sarco Thermostatic Steam Trap is about one-third the size and price of mechanical traps, yet it does the same work.
The Sarco saves in installation cost, too. It can be screwed right into the pipe line. Saves building a platform or digging a pit. Doesn't leak or waste steam. Cannot air bind.
Make every unit independent of every other by individual trapping. That insures just the right supply pressure for each unit, eliminates radiation loss and prevents holding up water.
Sent on 30 days' free trial.
Write for booklet AF-95.
SARCO HELICAL TUBING
SARCO CO., Inc.
183 MADISON AVE., NEW YORK, N. Y.
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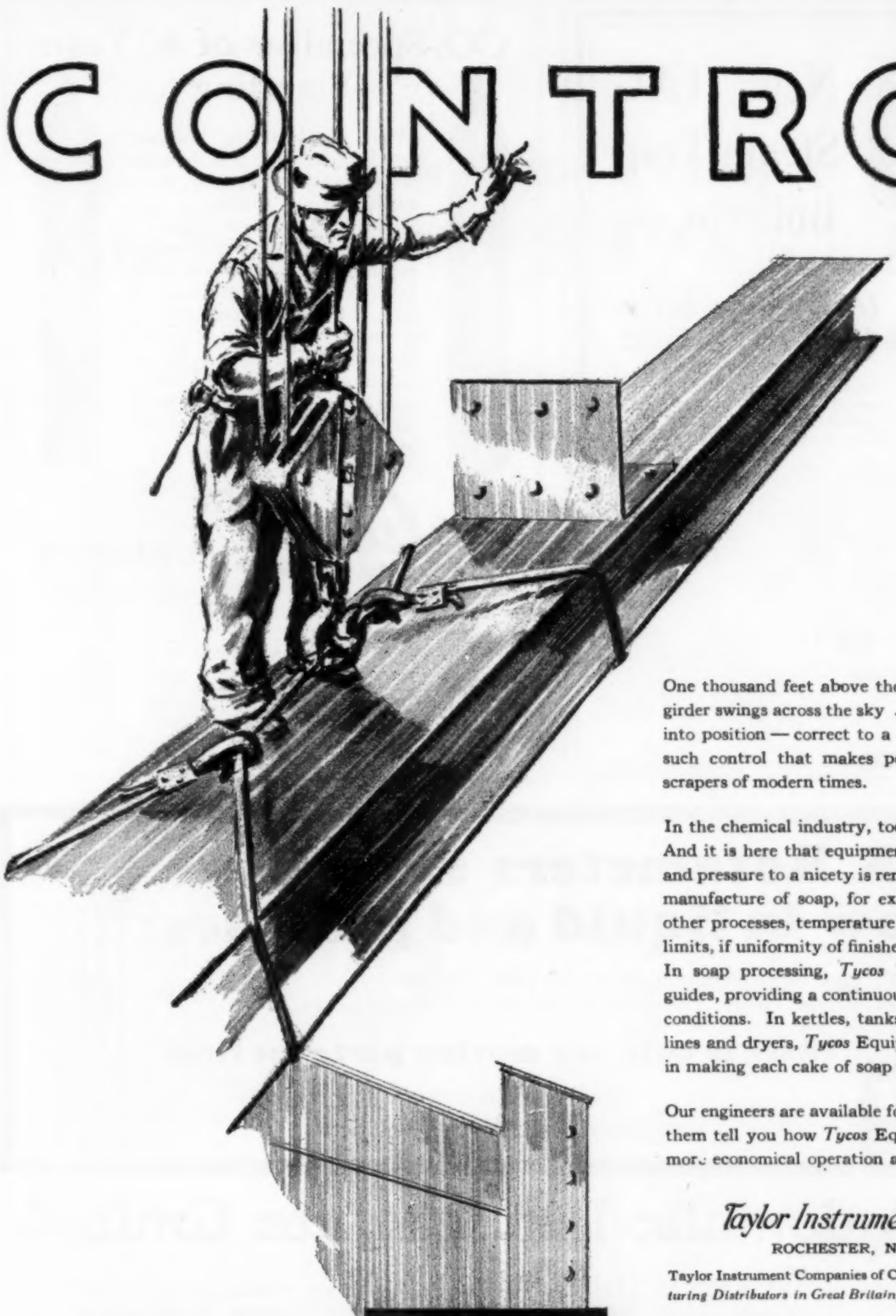
# CONTROL



One thousand feet above the sidewalk . . . a massive girder swings across the sky . . . skillful hands guide it into position — correct to a fraction of an inch. It is such control that makes possible the towering skyscrapers of modern times.

In the chemical industry, too, control is a vital factor. And it is here that equipment controlling temperature and pressure to a nicety is rendering real service. In the manufacture of soap, for example, during drying and other processes, temperature must be kept within close limits, if uniformity of finished product is to be assured. In soap processing, *Tycos* Instruments are constant guides, providing a continuous check on manufacturing conditions. In kettles, tanks, glycerine storage, steam lines and dryers, *Tycos* Equipment assists the engineer in making each cake of soap identical with its neighbor.

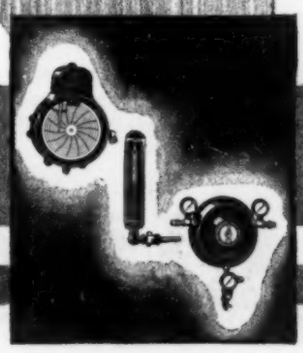
Our engineers are available for consultation. Let one of them tell you how *Tycos* Equipment can assist you to more economical operation and to product uniformity.

*Taylor Instrument Companies*

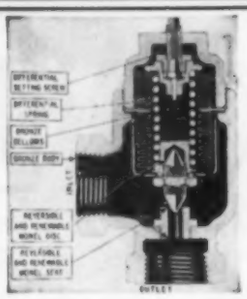
ROCHESTER, N. Y., U. S. A.

Taylor Instrument Companies of Canada, Ltd., Toronto. *Manufacturing Distributors in Great Britain,* Short & Mason, Ltd., London.

*Tycos* TEMPERATURE INSTRUMENTS —



INDICATING RECORDING CONTROLLING



# New TAG Steam Trap Bulletin ----

## *Send for it* . . . then get a Trap for 30 Days FREE Trial

TAG now offers industry a Thermostatic Steam Trap with many new and unique features including the TAG Differential Setting Feature . . . a sure guarantee of actual saving of steam dollars.

TAG has prepared a most interesting bulletin giving in full detail the advantages of the TAG Differential Setting Feature and the many other fine points which make this an outstanding trap. Use the coupon to get your copy. Use the same coupon to take advantage of TAG's 30 Day FREE Trial Offer. No strings attached. You get a TAG Steam Trap to test in your own plant for 30 Days FREE.

C. J. Tagliabue Mfg. Co.

**C. J. Tagliabue Mfg. Co.**

Park & Nostrand Aves.

Brooklyn, N. Y.

Gentlemen:
Please send copy of Bulletin 1015-10. Also send Trap. After 30 days we will either return or accept invoice at $12 Net, F.O.B. Factory.

Name .....

Address .....

# $CO_2$ Specialists of 40 Years Standing

When you buy Red Diamond $CO_2$ you can be sure of the same uniform high quality in every cylinder. For quality is safeguarded by laboratory control throughout every step of manufacture. Daily tests are made as a final precaution to insure each day's output measures up to the high standards set by our chemists. There is a Liquid distributing depot or jobber near you. Write for our booklet, "The Uses of Carbon Dioxide Gas."

"The Liquid" Carbonic Corporation

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# S & K Rotameters show rate of flow in liquid and gas lines

They give direct readings in cu. ft., gals., lbs., etc.
Sizes $\frac{1}{4}$" and larger. Horizontal and vertical upflow pipes.

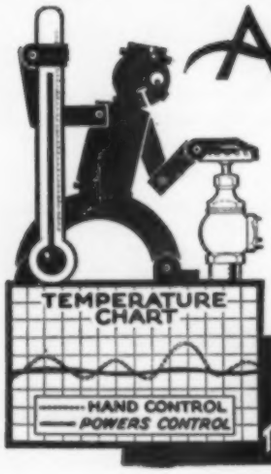
**There is only one moving part—the float**

Send for descriptive circular

1190 Thompson St., Philadelphia, Pa.

SCHUTTE KOERTING

# Automatic Temperature Control




TO ERR IS HUMAN—eliminate the errors of hand control of temperature with the mechanical accuracy of a Powers Regulator. It will quickly pay for itself by speeding up production—helps you to get a still better and more uniform product, and stops steam losses due to overheating. Let our engineers study your problems of temperature control and recommend the type of regulator that will give the best results at the lowest cost.

CHICAGO—2727 Greenview Ave. NEW YORK—231 E. 46th St.

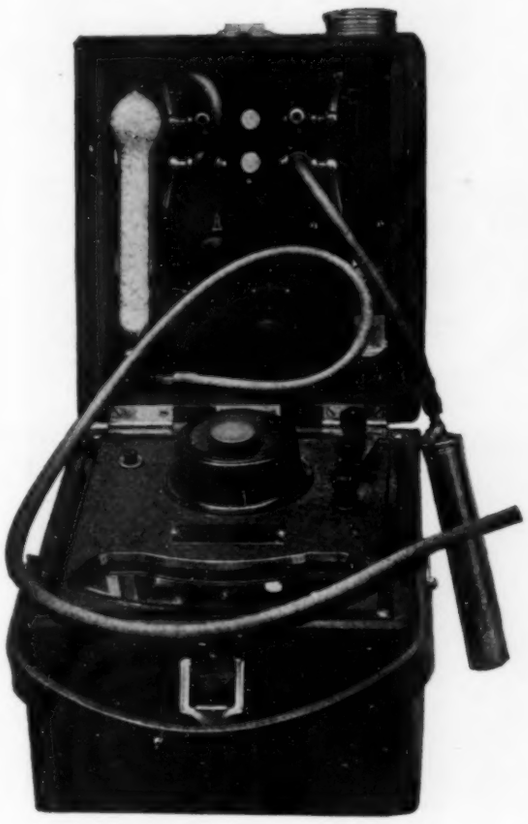
*Offices in 41 Cities*

THE POWERS REGULATOR CO.

OFFICES IN 40 CITIES

40 YEARS OF SPECIALIZATION IN HEAT CONTROL

# Taken for a ride, the "GASALYSER" tells the facts



A transportation company purchased this one.

It seems they're rather finnicky about the comfort and health of their passengers. So, at frequent intervals, this "Gasalyser" is taken for a ride in the passenger coaches to analyse the air, to check the $CO_2$ content.

Just an example of one of the many uses to which a "Gasalyser" is being put.

In industrial processes where gas analysis is vital, this portable, snug, compact, and easy-to-operate instrument, at its new low price, proves an investment well worth while.

Shouldn't a "Gasalyser" be taking a ride to your plant?

*Have you sent for the "Gasalyser" Bulletin?*

**Chas. ENGELHARD Inc.**

233 N. J.R.R. AVENUE NEWARK, NEW JERSEY

STANDARD FOR 30 YEARS

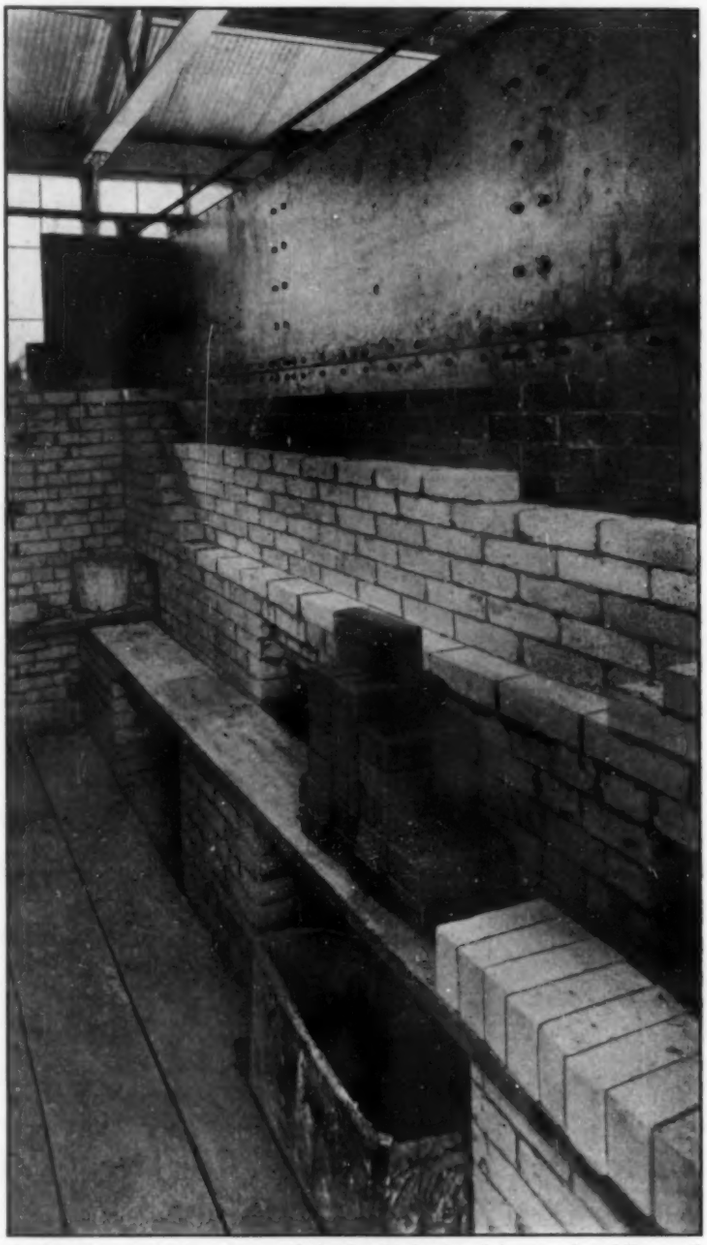
Recording and indicating instruments, automatic temperature and gas control, pyrometers, gas analyzers, thermocouples, thermometers.

Chicago; New York; Boston; Pittsburgh; St. Louis; R. E. Chase & Company, Tacoma, Wash.; Jensen Instrument Company, Los Angeles, Cal.; Cleveland Laboratories, Inc., 1988 East 66th St., Cleveland, Ohio. Exclusive Western and Mid-Western Engineers and Service Station.

# DOUBLE LAYER INSULATION

## *saves fuel*

### *Armstrong's and Nonpareil Insulating Brick stop heat waste in Cowan Kilns*



*Good insurance against heat loss . . . that's what this barrier of Armstrong's and Nonpareil Insulation furnishes in the Cleveland plant of the Cowan Pottery Company.*

FIREBRICK inside . . . steel shell without. And in between, a double layer of Insulating Brick—Armstrong's and Nonpareil. That's how Cowan Pottery Company insures against heat loss in the new down-draft kilns of its Cleveland plant.

It's good insurance, too, as others besides Cowan have learned. For both of these Armstrong Brick are built to guard high temperatures. In kilns and lehrs of every type and size, they are saving thousands of dollars yearly by preventing heat loss. Many instances are on record where the installation of insulating brick has resulted in fuel savings of from 10% to 40%.

There's added economy in the fact that both Armstrong's and Nonpareil Insulating Brick are accurately machine-sized. That means faster laying, with a tighter, more efficient wall. These brick often are laid up dry, saving labor and materials. Their exceptionally high salvage value represents an additional saving.

Armstrong's Insulating Brick are burned at more than 2500° F. They serve efficiently under temperatures as high as 2500° F. behind the refractory, without warping or fusing. Nonpareil are safely used up to 1600° F. Both are light and have ample strength for any type of construction. They are furnished in all standard firebrick sizes, and in special shapes to order.

Armstrong engineers will gladly help you, just as they did Cowan, plan savings in your own plant with these brick. Samples of each sent on request. Armstrong Cork & Insulation Company, 919 Concord Street, Lancaster, Pennsylvania; Canadian offices in Montreal, Toronto, and Winnipeg.

*Armstrong's* (A) *Product*

## *Armstrong's and Nonpareil Insulating Brick*

***for Furnaces, Boilers, Kilns, and Lehrs***

# ALCO
# HEAT EXCHANGERS

## FOR REDUCING COSTS IN THE PROCESS INDUSTRIES

HEAT EXCHANGERS
EVAPORATORS
FLUID COOLERS AND HEATERS
VAPOR CONDENSERS
REFLUX CONDENSERS
AMMONIA CONDENSERS
INTER AND AFTER COOLERS
DISTILLERS
STILLS

ALCO PRODUCTS INC.

WHEREVER large quantities of hot fluids are discarded as waste by the process industries, large sums of money are usually lost in the form of valuable heat . . . Some idea of the possible magnitude of such losses in your own plants can be obtained by making the following check:

1. Type of waste fluid
2. Quantity
3. Average temperature (degrees F.)

The result of this simple investigation may be the discovery of a surprisingly large source of preventable loss.

Alco is prepared to cooperate with you in studying your needs for heat exchangers, and to supply you with the most modern equipment. A consultation with us may result in major economies for your plants.

## ALCO PRODUCTS · INCORPORATED

MAIN OFFICE: *220 East 42d St., New York* · DISTRICT OFFICES: *McCormick Bldg., Chicago; Terminal Tower Bldg., Cleveland; Esperson Bldg., Houston, Tex.; Barr Bldg., Washington, D.C.; Philtower Bldg., Tulsa, Okla.* · Plant at Dunkirk, N.Y. · *Cable Address:* Alproducts

DIVISION · OF · AMERICAN · LOCOMOTIVE · COMPANY

*The Multiclone*

## — — — by the makers of COTTRELL ELECTRICAL PRECIPITATORS

■

## *Multiclone Dust Collectors*

A more efficient centrifugal dust collector with lower power costs. Has no moving parts to wear out. Turbulence reduced to minimum. Collected dust mechanically removed. Small amount of floor space required. Unit construction facilitates handling, installation, and the adding of additional capacity. Maintenance and operating costs minimum.

## *Peebles Spray Dryers*

Produces high grade powdered products from suspensions or solutions in one step at a minimum fuel, labor, and power cost. It is the practical result of a number of years of intensive research and development. Occupies small floor space, has low maintenance, is automatic in operation and free from shut-down interruptions.

*Send for illustrated, descriptive literature.*

*For information on Multiclones, write to*

**WESTERN PRECIPITATION COMPANY**
**at New York, Chicago, Montreal, or Los Angeles**

*For information on Spray Dryers, write to*

**WESTERN PRECIPITATION COMPANY**
**at Los Angeles**

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**CHEMICAL ENGINEERS**
**COTTRELL ELECTRICAL PRECIPITATORS**
**MULTICLONE DUST COLLECTORS**
**PEEBLES SPRAY DRIERS**
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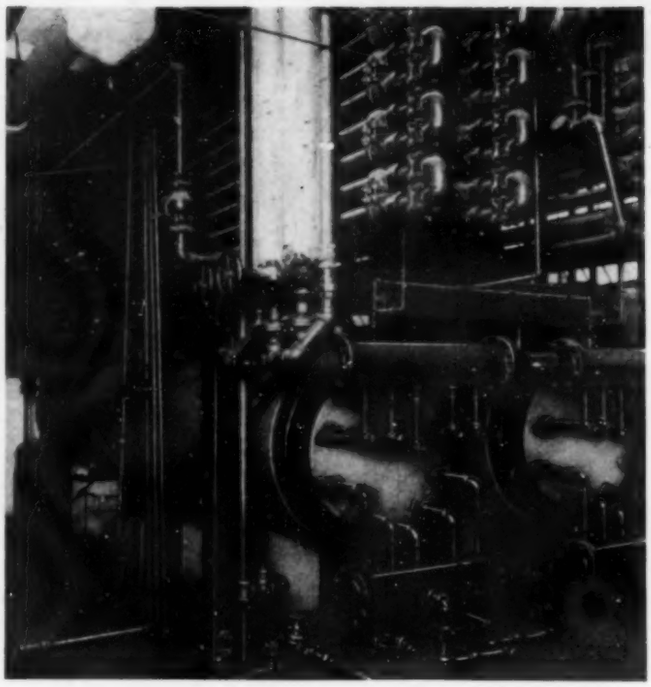
LODGE-COTTRELL, Ltd., George Street [Parade], Birmingham, England





## Less than ⅓ mechanical H.P. per ton

### *with exhaust steam refrigeration*

Exhaust steam from your power plant or generating system! The only other energy needed is less than ⅓ mechanical H.P. per ton of refrigeration—the power required to operate the brine, ammonia and water pumps. ¶ There is no other system so inexpensive to operate. None that has so few moving units, that can be depended on to a greater degree for dependable service—providing exhaust steam is available. ¶ Whether it be for freezing, cold storage or air conditioning, the Carbondale Exhaust Steam Refrigerating System is worthy of serious consideration. ¶ Carbondale Engineers offer you the benefit of their more than forty years of refrigerating experience. They will gladly assist in planning the most economical system for any refrigerating service.

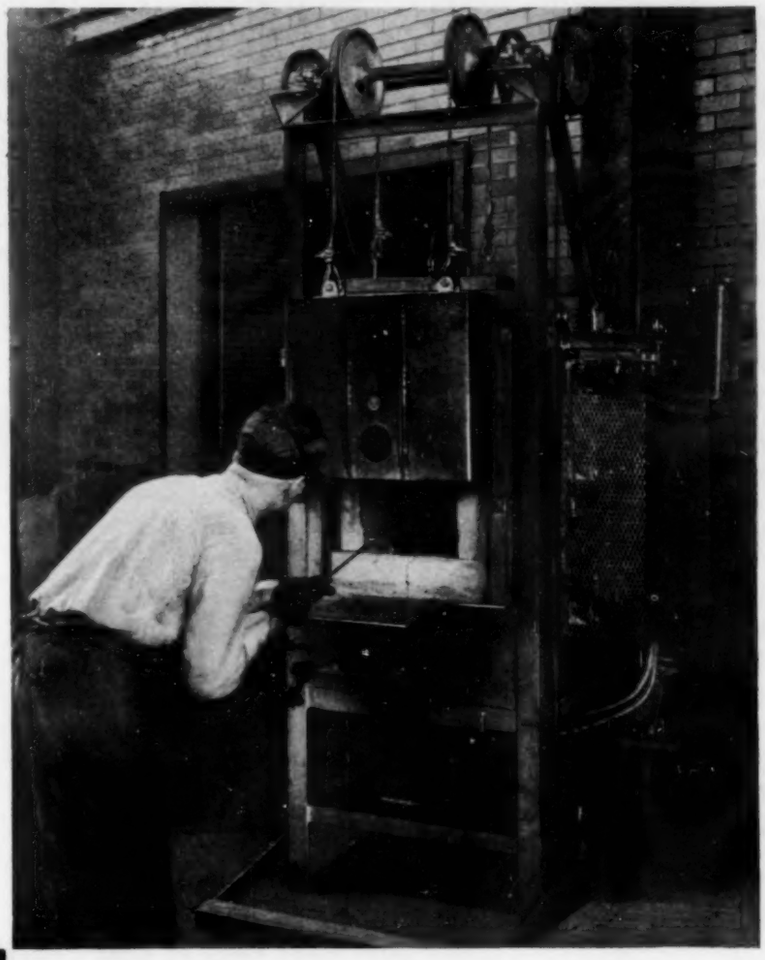
THE CARBONDALE MACHINE CO.
Carbondale, Pa. *Branches in principal cities*
*Canadian Carbondale Co., 102 Lombard St., Toronto, Ont.*

**Carbondale Refrigeration**

ABSORPTION AND COMPRESSION AMMONIA ARMAC SYSTEMS AND CO, COMPRESSION SYSTEMS

# Elements by "GLOBAR"- Furnace by Westinghouse-

REG. U.S PAT. OFF.



INVESTIGATE ELECTRIC HEAT

AND the equipment is in the shops of an internationally known ship-building company.

They report a much lower overall cost in heat treatment of high speed and carbon steel tools and in the treating of heavy forged chain links and other work typical in shipyard shops.

Globar Brand Elements in the high temperature Westinghouse furnace give a dependable, easily controlled, uniform heat.

Spoilage of tools has been greatly reduced—and they are turning out finer work than ever before.

*Tune in on*
**THE CARBORUNDUM HOUR**
Columbia Chain
SATURDAY NIGHTS
9.00 E.S.T.

## GLOBAR CORPORATION, Niagara Falls, N.Y.

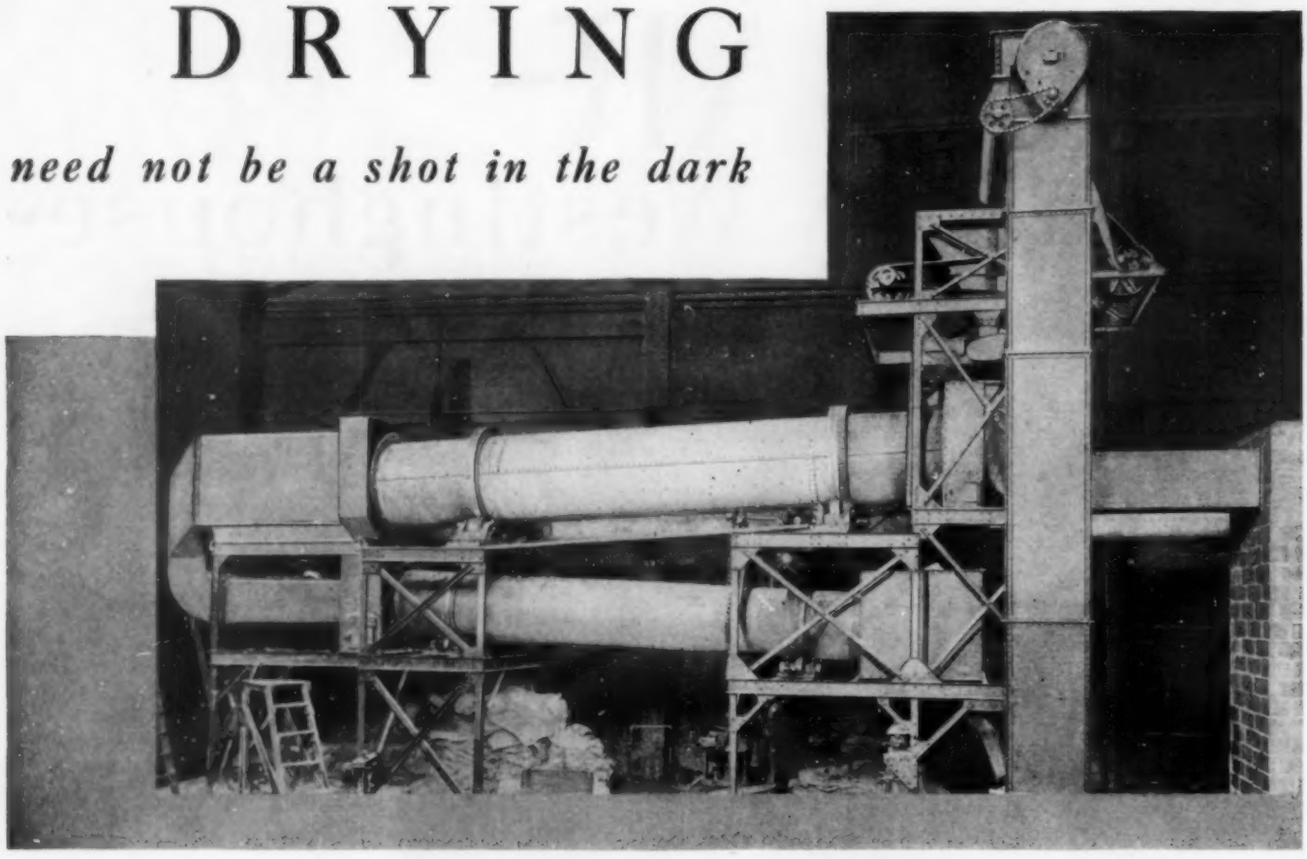
(A SUBSIDIARY OF THE CARBORUNDUM COMPANY)

WILLIAMS & WILSON, LTD., Montreal—Toronto, Canada
BRITISH RESISTOR COMPANY, LTD., Manchester, England
PACIFIC ABRASIVE SUPPLY CO., San Francisco and Los Angeles
STEINMETZ & COMPANY, Philadelphia

[GLOBAR IS THE REGISTERED TRADE NAME GIVEN TO NON-METALLIC ELECTRICAL HEATING AND RESISTANCE MATERIALS, AND TO OTHER PRODUCTS OF GLOBAR CORPORATION, AND IS ITS EXCLUSIVE PROPERTY]

# DRYING

## *need not be a shot in the dark*



When you ask Bartlett & Snow engineers to consider drying operations in your plant the discussion deals largely with *your* product and *your* materials. Is there some unsuspected advantage for you in this or that method of drying? Can drying add to your profits? What about costs? How can your present drying processes be improved or made more economical? These are the things you want to know. These are the questions to which Bartlett & Snow gives you specific answers that supply the information you need in making your decision.

Even for materials that have never been dried before, Bartlett & Snow engineers know how to approach the problem through study and research, to give you a recommendation that eliminates guesswork.

Bartlett & Snow engineers can make their recommendations definite because your problems are studied in the light of half a century of drying experience . . . and this fifty years of successful experience in dealing with drying problems makes it possible to tell you what you want to know about drying your material . . . the size and type of dryer you need . . . the investment required . . . the operating cost.

### *Get Your Copy of This Bulletin*

Bulletin No. 69 illustrates and describes Bartlett & Snow drying equipment and shows how many different kinds of materials can be dried successfully. Write for your free copy of Bulletin No. 69.

*THE C. O. BARTLETT & SNOW COMPANY · 6204 Harvard Avenue, Cleveland, Ohio*

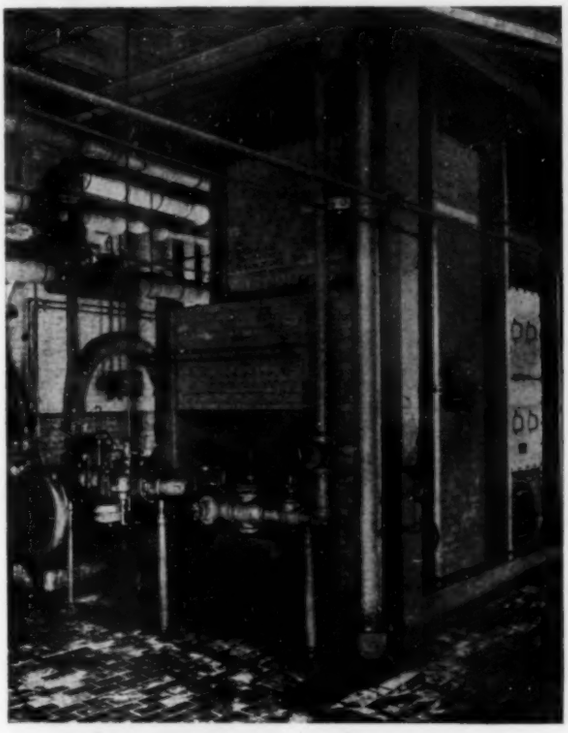
**For the Dominion of Canada**
PEACOCK BROTHERS, LTD., MONTREAL

**For Continental Europe**
Société Anonyme des Acieries ci-devant Georges Fischer Schaffhouse, Switzerland.

# BARTLETT-SNOW

**For Great Britain**
PNEULEC, LIMITED, SMETHWICK, NEAR BIRMINGHAM

# High Deodorizer Vacuum Easy with MERRILL PROCESS



**Absorber of Merrill Process System at plant of Armour & Co., Chicago**

***Booklet "A" describes the Merrill Process System.***

***If you convey liquids that must be kept hot while in transit, you will be interested in our booklet on Jacketed Piping.***

***Either piece of literature will gladly be sent on request.***

It is a simple matter to maintain a high deodorizer vacuum if you use a

**MERRILL PROCESS SYSTEM**
***of Industrial Heating by Oil Circulation***

**When vegetable oil is heated by this method, the entire batch stays in the deodorizer until completed, and there are no pumps, valves and pipe line joints that can allow air leakage.**

**At the plant of Armour & Company, Union Stock Yards, Chicago, a large Merrill Process System supplies heat for deodorizing vegetable oil. A constant supply of Circulating Oil at controlled temperature is delivered to the deodorizer, where the temperature of the vegetable oil is raised to 450° F.**

**The entire batch receives exactly the same treatment, and there is no overheating or discoloring of the vegetable oil film in contact with the heating surface, as is likely to occur with direct fire methods.**

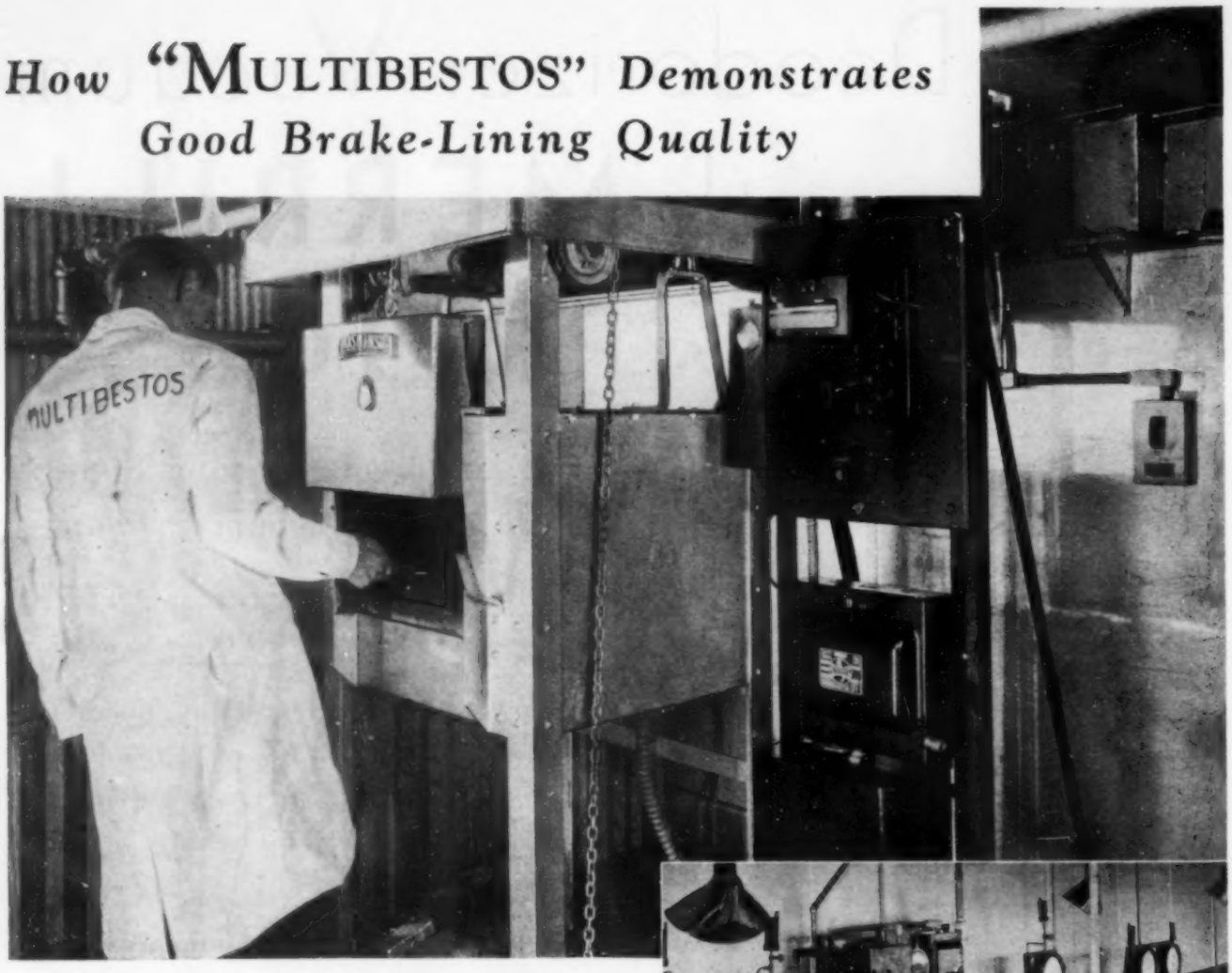
## Parks-Cramer Company

*Engineers and Contractors - - Industrial Piping and Air Conditioning*

**1102 Old South Building, Boston, Mass.**

*Represented in England and on the Continent by The Kestner Evaporator & Engineering Company, Ltd., London, England*

# *How* "MULTIBESTOS" *Demonstrates Good Brake-Lining Quality*




IN this Hoskins electric furnace, samples of molded MULTIBESTOS brake-lining are held at 600° F. for three hours, to establish its behavior under hard emergency road service. Photo-micrographs are then made of cross sections of these samples, thus visually demonstrating the resistance of "MULTIBESTOS" to heat. Actual break down tests are made with the equipment shown at the right. This illustrates how Hoskins furnaces can be used to establish strong selling points. If you have anything to do with the quality of your products, there is a Hoskins electric furnace which will be useful to you, too—for research to improve the product, and then demonstrate its quality. Ask for Catalog A53.

**Hoskins Electric Furnaces**

Originators and Manufacturers of Chromel The Alloy that made Electric Heat Possible

INVESTIGATE ELECTRIC HEAT

4435 Lawton Ave. HOSKINS MANUFACTURING COMPANY Detroit, Mich.
In Canada: Walker Metal Products, Ltd., Walkerville, Ont.

# MONARCH
## "NON-CLOG"
## SPRAY NOZZLES

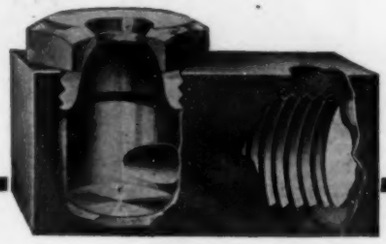


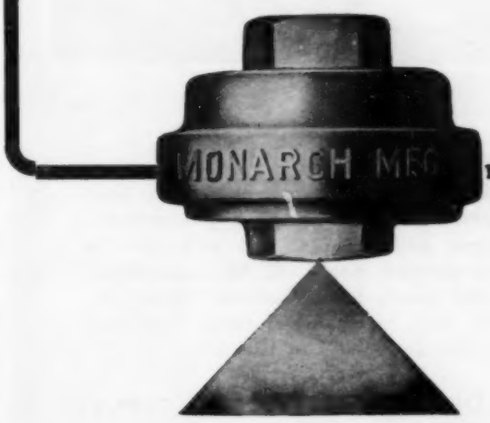
Fig. 631

**Any impurities small enough to pass orifice of this nozzle will never clog the leading hole. Made in 15 capacity sizes from 4.7 to 2050 GPH at 40 lbs. also furnished ⅜" male thread for capacities up to 172 GPH. Made of yellow brass, steel, monel, etc. Used for washing air, scrubbing gases, etc. Price very low.**

•

**Our Fig. 645 nozzle illustrated below is made of cast brass, Everdur, etc., and therefore has much better wearing qualities.**

***Write for Catalog No. 6-C.***




**MONARCH MFG. WORKS, Inc.**

2730 E. Westmoreland Street
PHILADELPHIA, PA.

Harrison Sales Co., 314 Ninth Ave. N., Seattle, Wash.
W. F. Pyne, 909 S. Ardmore Ave., Los Angeles, Cal.

# Get this Booklet before you buy Heating Equipment

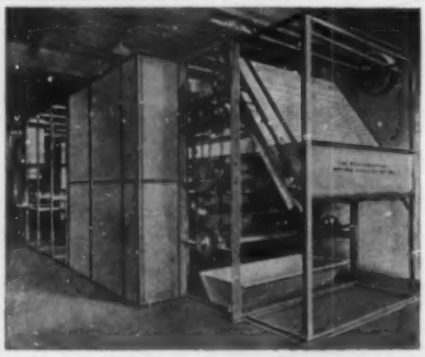
Hundreds of executives have asked for information on Buffalo Gas Unit Heaters — the units that provide CLEAN, ECONOMICAL HEAT — be sure that YOU have all the facts about MODERN Gas Heating before you buy any kind of heating equipment.

A line on your letterhead will bring a copy of the booklet.

**Buffalo Forge Company**
**501 Broadway, Buffalo, New York**
***In Canada:***
**Canadian Blower & Forge Co., Ltd.**
**Kitchener, Ontario**

"Buffalo" **Gas Unit Heaters**

**Floor and Suspended Type**



"Hurricane" Multiple-pass Automatic Tray Dryer

Panels removed to show construction.

# CONTINUOUS DRYERS
## LOWER COSTS

MANY products can be dried in Continuous Automatic machines at a great saving in time, labor and floor space.

"Hurricane" Continuous or Automatic machines are made in many models: Automatic Dryers of the tray type for chemicals; Continuous Conveyor Dryers for ceramic products and enamel ware; Pole and Chain Dryers for yarns; Automatic Loop Dryers for fabrics; Apron Machines for fibrous materials, etc.

We also build Tray Dryers and Tunnel Truck Dryers for manual operation.

Write for Bulletin Ind-1: "Dryers for the Industries."

341

**THE PHILADELPHIA DRYING MACHINERY CO.**
3351 Stokley St., Philadelphia, Pa.

*Plant of McDanel Refractory Porcelain Co.*

# Quality Refractories
## Standard or Special Design

On the better types of pyrometers you will find McDanel Pyrometer Tubes. What better evidence of quality and acceptance could you ask?

McDanel also manufactures Pyrometer Tubes, Pyrometer Insulating and Protection Tubes, Combustion Tubes, Porcelain Grinding Balls, Porcelain Brick for lining Ball Mills and Special High Temperature Products. *Write for details.*

**In specifying McDanel Tubes from your pyrometer man you will be assured of the best service obtainable.**

**McDanel Refractory Porcelain Co.**
**Beaver Falls, Pa.**

# ROASTING - CALCINING DRYING

**Perhaps you, too, have a roasting, calcining or drying problem to solve.**

**The ever-growing army of Nichols Herreshoff furnaces has successfully defeated these problems time and time again.**

**We invite you to consult us and avail yourself of our experimental furnace and laboratory, and our experience in solving your particular problem. Because of recent expansion, we are now, more so than ever before, in a position to render you service and satisfaction**

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**Crucibles, muffles, scorifiers—all are built to combine high thermal conductivity, strength under loads, and resistance to severe thermal shock. All DFC metallurgical clay goods have "survival value" because they are made from materials carefully analyzed and tested**

**THE DENVER FIRE CLAY COMPANY**
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# One of the World's Largest Bubble Towers

Two interesting publications describing The Babcock & Wilcox Fusion Welding Technique and Special Process Equipment will be sent upon request . . . simply ask for Bulletins S-9 and S-10.

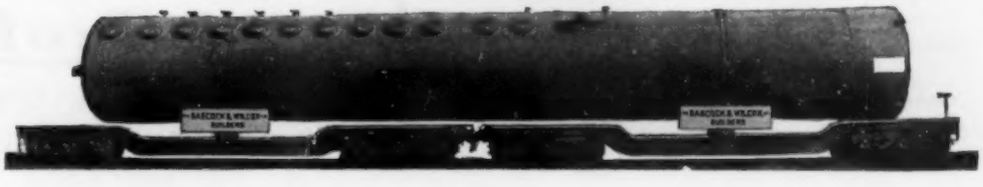
THIS bubble tower and gas oil accumulator, built by The Babcock & Wilcox Company for the Lummus Company, will be installed at the Bayonne, New Jersey Refinery of the Tidewater Oil Company.

Constructed of 1-1/4" steel plate to withstand 150 pounds per square inch pressure at 700° F. maximum temperature, this tower is 12' 0" O. D., over 93' long, and weighs more than 325,000 pounds.

All seams are welded by The Babcock & Wilcox Fusion Welding Technique which includes automatic welding, X-Ray inspection, and stress relieving in one of the largest annealing furnaces ever constructed. That this Company is well able to fabricate any type of pressure vessel in sizes limited only by railroad shipping clearances is conclusively proved by the delivery of this outstanding order.

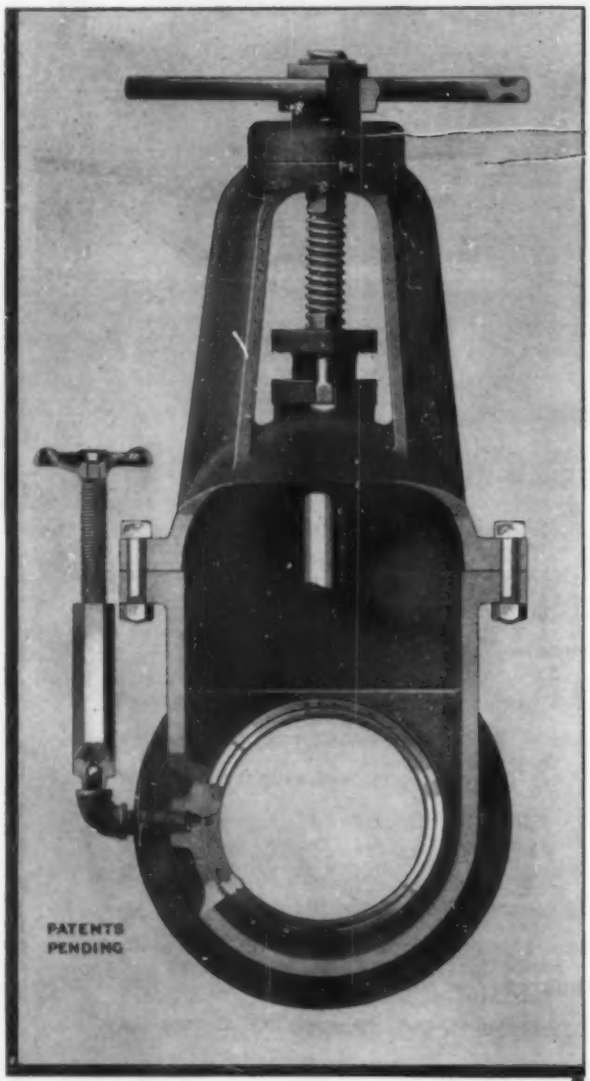
THE
**BABCOCK & WILCOX**
COMPANY

85 LIBERTY ST. NEW YORK, N. Y.



S-1

# NEW LUBRICATING FEATURE BIGGEST IMPROVEMENT IN TWENTY-FIVE YEARS




## TIGHTER SEATING, EASIER OPERATION, LESS MAINTENANCE AND LONGER LIFE

### Lubrotite Gate Valves are the Solution to Hundreds of Gate Valve Problems

This new principle in gate valves was originally developed for one of the large refineries. This refinery had tried gate valves of many different makes, but found that ordinary valves would last but a few weeks. After a short time, however, leaks would develop.

Lubrotite Gate Valves were installed. After many months of service under the hardest possible operating conditions, these valves today are performing as well as the day they were put into service.

In the Reading-Pratt & Cady Lubrotite Gate Valves, a lubricant is introduced under pressure between the disc and seats. This thin film of special lubricant protects the seats and the valve stays tight so long as the melting point of the lubricant-seal is not exceeded. Where foreign materials scratch the seats and cause the ordinary gate valve to leak, the Lubrotite Lubricant seals such leaks and prevents them from becoming larger. Where line conditions are such that it is necessary to take the ordinary valve apart in order to clean the seating surfaces, Lubrotite Valves remain tight.

Lubrotite Gate Valves open easier. Sticking is prevented by screwing down the lubricating guns a turn or two as the valve is being closed. Also, a turn of the guns will free a valve which has become stuck after being closed for a long time.

The Lubrotite feature is available in all Reading-Pratt & Cady Gate Valves. Tell us what your operating conditions are. Our engineers are at your service. The coupon at the left is provided for your convenience —fill in and mail today.

ACCO

An Associate Company of the American Chain Company, Inc.

**Lubrotite**

**IRON & STEEL GATE VALVES**

MADE BY **READING-PRATT & CADY, Inc.**

**MAIL TODAY for Complete Information**

READING-PRATT & CADY CO., *Inc.*
Bridgeport, Conn.

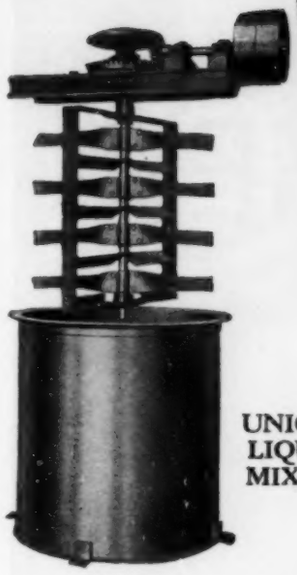
Please send by return mail, without any obligation whatever, complete facts about "Lubrotite" Gate Valves.

Company .....

Address .....

Name and Position .....

.....



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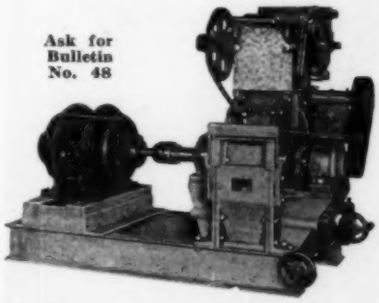
STANDARD AND SPECIAL MIXERS

A complete line of Mixers from small laboratory models to mammoth large capacity machines—for definite operations on an endless variety of materials. Now in successful use in processes for all kinds of food products, confections, salts, dyes and colors, soap products, ceramics and all kinds of chemicals. They mix quickly and thoroughly, operate with the minimum power consumption and require practically no attention.

**Write for Mixer Bulletin No. 32-B**

Ask for Bulletin No. 48



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Powerful, compact, efficient mills, adjustable for various degrees of fineness. The Pulverizer shown is of an advanced design for uniformly reducing such materials as chemicals of all kinds, colors, dyes, clays, lime, gums, soaps, soda, sulphur, sugar, salt, spices, etc. Requires no separators, fans or collectors. Results are certain, always. Used extensively throughout the process industries.

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For all "siftable" materials. Ideal for sifting all sorts of chemicals, baking powder, dried eggs, milk powder, spices, salt, soda, etc. Built for making 1 to 5 separations. Many sizes.

***REMEMBER:—We offer a complete line of high grade process Equipment—PLUS—A helpful engineering and advisory service.***

# *Are you geared up for efficient operation?*

Plant equipment doesn't become out of date as rapidly as your automobile—but it does become obsolete. And obsolete equipment means slow production, costly labor and frequent repair bills.

Efficiency in plant operation is the guarantee of product quality, low operating costs and negligible maintenance expense.

Robinson process machines, operating as a unit, go a long way toward plant efficiency. Grinding, Crushing, Pulverizing, Proportioning, Sifting, Mixing — for each of these processes there is a Unique Machine of proven merit—proved by actual successful operation on hundreds of products under all kinds of operating conditions.

*Your plant can be efficient*

*IT'S UP TO YOU!*

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CRUSHERS
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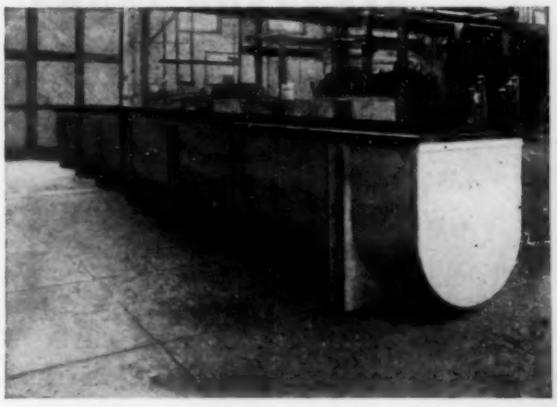
# STORAGE AND PICKLING TANKS

# ACE RUBBER LINED

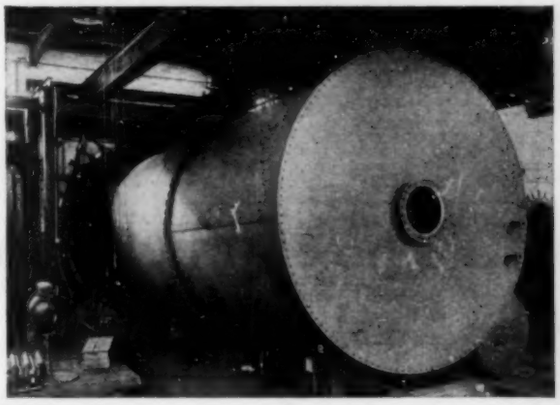


The Ace rubber lined tank, illustrated above, handles hydrochloric acid in pickling KA2 metal. It is made in two sections and when bolted together is made leak-proof by soft rubber gaskets which in the Ace process of lining tanks, are vulcanized directly to the face of the flange.

Tanks made in sections enable assembly in your plant, as well as permitting rail transportation.

*No tank is too large for us to permanently protect against acid corrosion with Ace Hard Rubber Lining.*

The 13,500 gallon capacity tank below stores the acid used in the pickling tank.



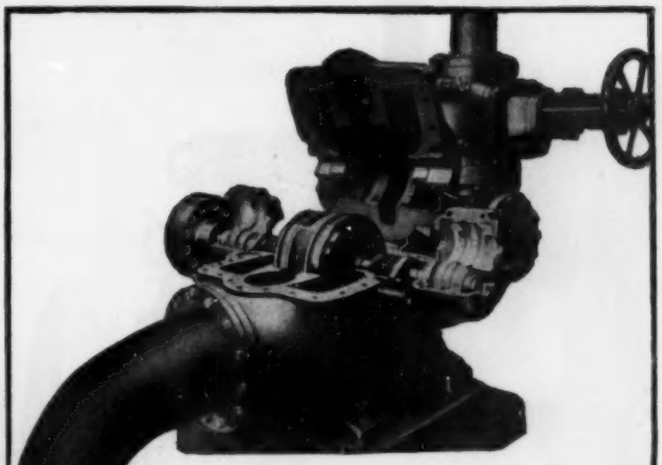
*Catalogue on request.*
*Write to*

**AMERICAN HARD RUBBER COMPANY**

**11 Mercer Street, New York, N.Y.**

**Akron, Ohio — 111 West Washington Street, Chicago, Ill.**

ACE HARD RUBBER *Prevents Corrosion*



## A Packing that Withstands the Destructive Action of Sulphuric Acid

SUPER CUTNO PACKING

is the result of long experiments to produce a packing that will give a satisfactory length of service against the most difficult of all acids — Sulphuric — and those acids similar to it, especially at elevated temperatures.

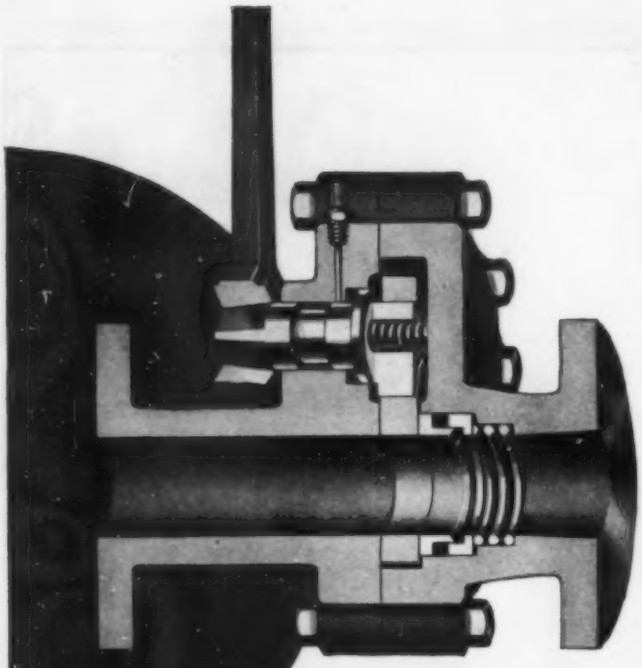
SUPER-CUTNO can be depended upon to withstand the destroying quality of Sulphuric and those acids of a similar nature and to give a length of service entirely unknown to any packing heretofore offered for this service.

**We would like to send you a free working sample to test out under your own peculiar conditions.**

**State size and quantity required for test.**

GREENE, TWEED & CO.
*Sole Manufacturers*
109 Duane Street
New York

**SULPHURIC ACID**



## THE QUICK OPENING VALVE OF LOW MAINTENANCE COST

THERE are nine good reasons why Yarway Pretite Valves are used by such firms as the Champion Fibre Co., du Pont Rayon Co., Endicott Johnson Corp., U. S. Aluminum Co., Procter & Gamble Co., American Cyanamid Co., and many others. They are:

- **First:** Quick opening, 90° travel of lever opens or closes valve.
- **Second:** Straight through, non-clogging flow.
- **Third:** One piece solid disc with seating surface on both sides, protected from corrosion or erosion.
- **Fourth:** Unique Pretite feature which employs a sealing bushing on inlet side of the disc, hence double-tightening.
- **Fifth:** Disc in contact with its two seats through entire opening and closing cycle.
- **Sixth:** Sealing bushing is pressure-and-spring-packed.
- **Seventh:** Alemite lubrication for ease of operation.
- **Eighth:** Valves built of special metals to suit the particular condition of service.
- **Ninth:** Moderate cost.

Investigate Yarway Pretite Valves as a possibility for speeding production and cutting costs in your plant. Send for Bulletin P-501.

YARNALL-WARING COMPANY
7700 Devon Street Philadelphia

YARWAY
PRETITE VALVES

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**SPECIAL STEEL PLATE EQUIPMENT**
***for* PRESSURE *or* VACUUM PROCESSES**

**SPECIAL *and* STANDARD TANKS**

**STACKS BREECHING STEEL PIPE**

**GRAVER TANK & MFG. CORP.**
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*Fabricators of*

# GRAVER

**SPECIAL PLATE CONSTRUCTION**

*also*

Water Treating Equipment
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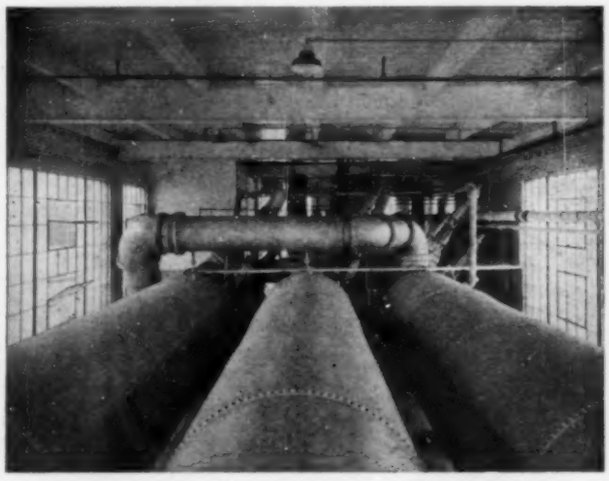


## A Three Absorber Unit

A recovery capacity of 1500 gallons of mixed solvents in 8 hours is represented in the above carbon absorption unit.

32,000 feet of exhaust air is stripped of vapor each minute, over 85 per cent of the solvent being reclaimed.

Operation of the complete plant, erected by us, requires but one attendant.

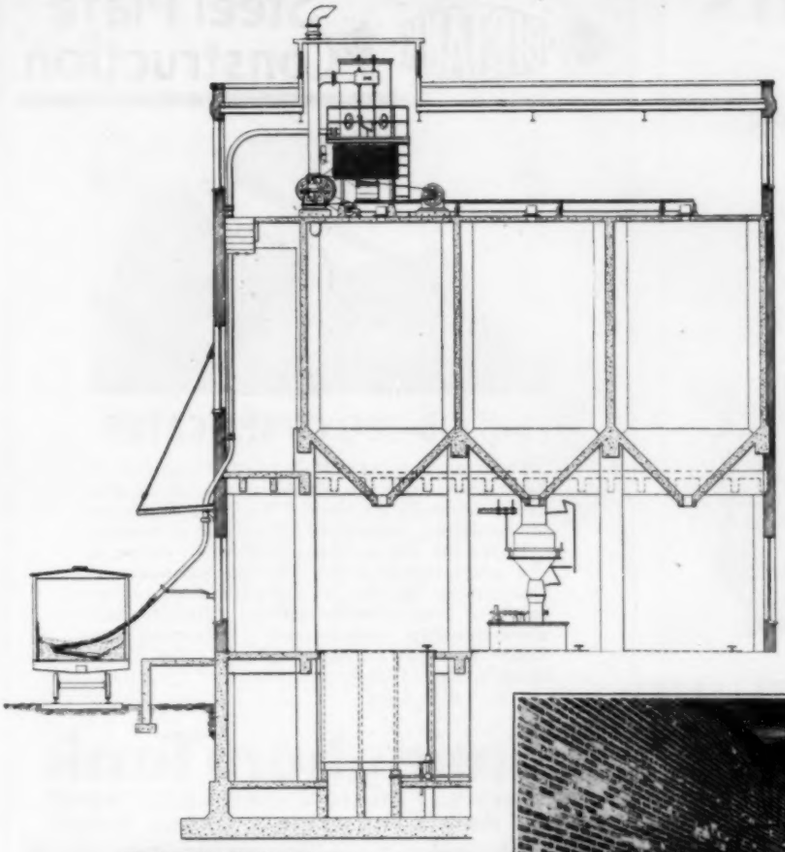
Estimates on a plant, to meet your peculiar conditions, will be gladly furnished.

**American Solvent Recovery Co.**
COLUMBUS OHIO

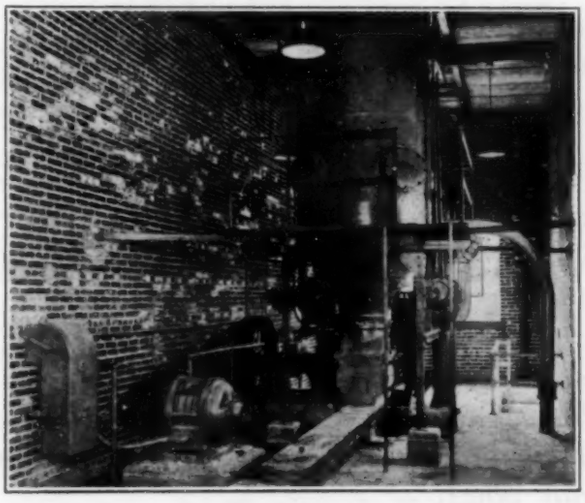
# IF YOU USE SODA ASH BY THE CAR LOAD—

*save money with the*

# AIRVEYOR



Typical installation of Airveyor with automatic dust filter. An air-lock feeder discharges into a screw conveyor, which distributes to three bins. Where bins are remote from the siding, a pipe line system is substituted for the screw conveyor and exhaust air conveys the material to the delivery points.



The motor shown in the foreground drives the exhauster, feeder, filter and conveyor.

**The price differential between bulk and bagged shipments is not the only saving. Pneumatic conveyors reduce handling costs and distribution is quick and simple. (One man operates the conveyor). Dust losses and dust nuisances are eliminated.**

## OTHER MATERIALS

**commonly handled by the Airveyor include:**

| | | |
|---|---|---|
| Lime | Copra | Fullers Earth |
| Clays | Shells | Salt Cake |
| Alum | Malt | Soya Beans |
| Grains | Coal | Wood Flour |
| Salt | Resin | Gypsum |
| | Arsenic | |

**The Airveyor is available in a full range of capacities to meet all plant requirements in the pneumatic handling of fine, crushed and granular materials. These include simple vacuum systems for unloading one box car at a time to large travelling marine combinations of 6 and 8 units. The Airveyor is furnished in suction, pressure and combined types, for unloading, for recovering from warehouse storage and for distribution to remote parts of the plant.**

**This pipe line conveyor is readily adapted to existing buildings and can be installed without interfering with plant operation.**

**A large number of installations in representative light and heavy chemical plants makes our Engineering Department particularly well qualified to suggest the most favorable type of Airveyor to meet your specific requirements.**

**Typical installations are illustrated in our bulletin A-2.**

## OTHER PRODUCTS

**Fuller-Kinyon Portable and Stationary Conveying Systems, for dry pulverized materials—Rotary Compressors and Vacuum Pumps—Feeders for pulverized materials.**

# Fuller Company

## CATASAUQUA, PENNA. U. S. A.

# NATIONAL COILS
## *Preferred by*
## Process Industries

Engineers of the Chemical, Rubber, Distilling, Paper, Explosives, Oil, Refrigeration and other process industries are of one mind when it comes to purchasing coil equipment. They want the best, and they specify National Coils.

NATIONAL has been serving these industries with reliable coil equipment for nearly fifty years. No wrinkles or flats in National Coils, perfect workmanship on every job, large or small. Send us your specifications.

**National Coils fabricated in:**

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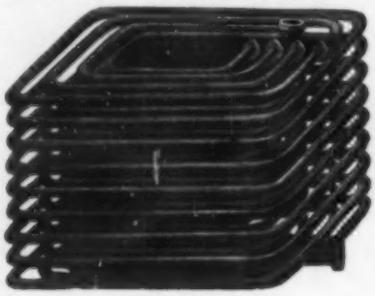

National Box Coil

**Storage, Feed Water, Instantaneous Heaters. Coolers.**

THE NATIONAL PIPE BENDING CO.
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## NO JOB TOO COMPLICATED

Here is a special still we made to specifications for use in the oil industry. It weighs approximately 23 tons. We have facilities for handling plate work of any size or design.

Write for list and description of some of the special plate work we have turned out. Quotations promptly submitted upon receipt of your specifications. Quality and workmanship guaranteed. Birmingham Tank Company, Birmingham, Ala., and Verona, Pa. (Pittsburgh Dist.).

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PLATE AND STRUCTURAL STEEL WORK



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***You pay no excess freight when you buy Niacet 99.5% Glacial Acetic Acid in aluminum containers. No handling loss . . . no breakage . . . no discoloration . . . and if you want to use dilute acetic in your process, the water can be added at your plant.***

ALUMINUM TANK CARS—65000 LBS.
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For handling pulp, slurry, sludge, sand, chemicals, and all other semi-solid, abrasive and corrosive materials. Also clear-water pumps for boiler feed, fire protection, water supply, and general service, for all capacities, loads, and methods of drive.

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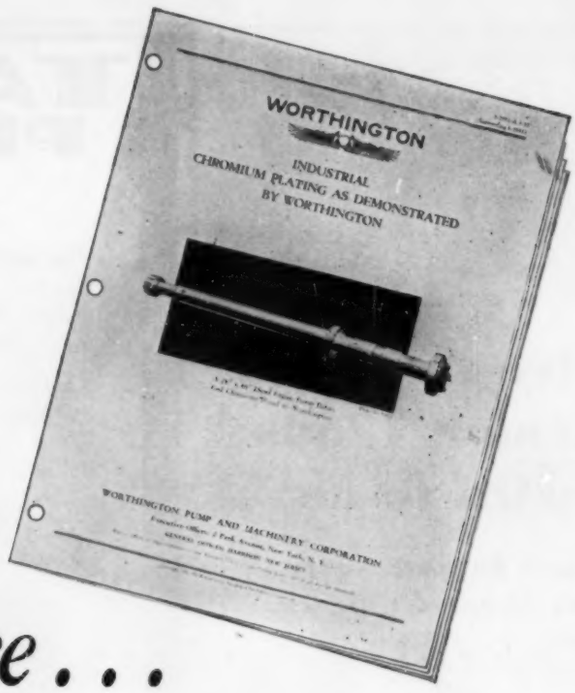


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## are chromium plating stories *that may amaze you!*

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Forging Furnaces
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CHROMIUM PLATING
*Literature on request*

C-3

YOU know chromium plating as used on your automobile and household fixtures . . . but do you know also of its remarkable industrial applications?

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Industrial chromium plating has been pioneered by Worthington. A wealth of experience and scientific knowledge has been acquired. The story of what Worthington has done and is equipped to do in this field is told in an interesting illustrated bulletin, S-2001-A. A copy is yours for the asking.

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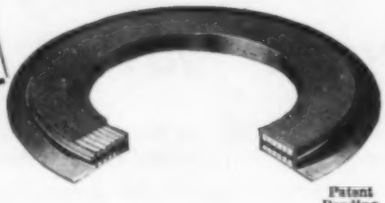
***Prove to yourself that these Gaskets are . . .***

The right PREVENTIVE for GASKET TROUBLES



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**This is what Flexitallic Armor Clads will do:**

These Armor Clad Gaskets, because of exclusive features in Flexitallic construction, will cope with the most severe conditions—pressure, acid, expansion and contraction, superheat, variable load, oil, corrosive vapor, vibration, condensation . . .

They'll go into place, do their work faultlessly, stay tight without hard pull-down or follow-up, and they'll go back into service again and again. They're built to be reusable.

**This is why they can do all that:**

(1) The armor is made of the right metal for the job—stainless steel, monel, copper, whatever metal is required. (2) Metal is double-thick at point of greatest need for strength. (3) The inside of the patented Armor Clad is a Flexitallic Gasket made of alternate strips of metal and asbestos wound in a tight spiral, nineteen plies to the inch. Each metal strip is so shaped that it exerts a spring-like push against the squeeze thus giving Flexitallic resilience and flexibility. The spring-like character is retained, and the Gasket is not only faultless in service but reusable many times.

**Give them the JOB to do**
***. . . they'll convince you!***

FLEXITALLIC
GASKET COMPANY
8th and Bailey Sts. • Camden, N. J.

TABER PUMPS

PRICED RIGHT

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Your request for quotation will show you our price is right. What are your needs? Write us, requesting comprehensive Bulletin G-631.

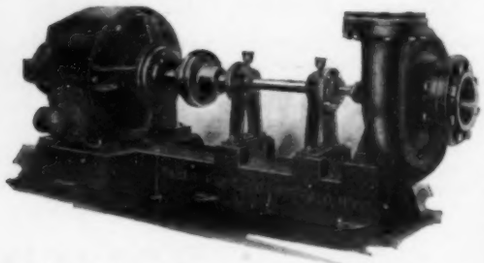
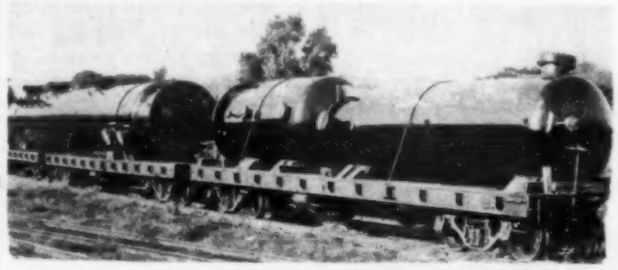


*Fig. 603-G. Impeller is kept in true position. Stuffing Box is four shaft diameters deep. An extra value pump.*

TABER PUMP CO.
294 Elm Street, Buffalo, N. Y. Est. 1859



WELDED PRESSURE VESSELS
with H-W-W "HY-PRESSURE" Weld

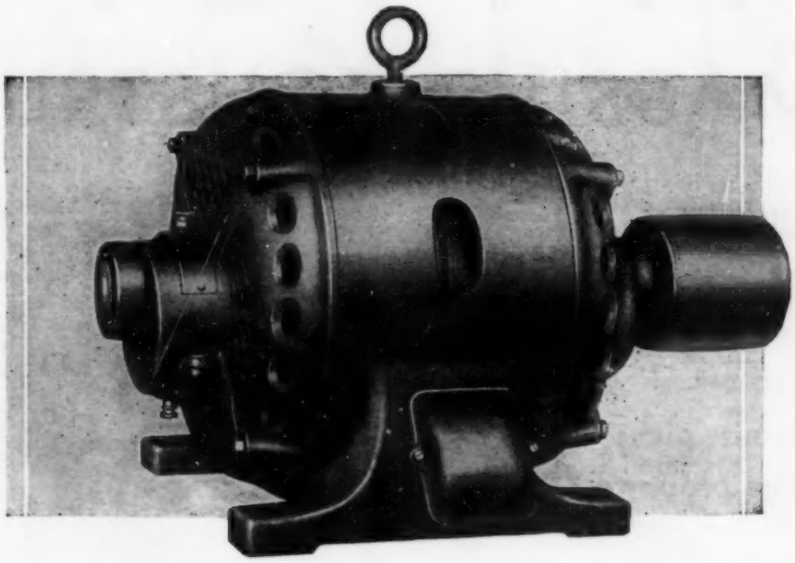
TESTS show that the metal in the weld of H-W-W HY-PRESSURE Vessels is more resistant to corrosion than the base metal. Send for sample of H-W-W HY-PRESSURE Weld and make corrosion tests.

H-W-W HY-PRESSURE Welded Vessels conform to A.S.M.E. Code. Welded seams are X-Rayed in our plant.

Let us quote on your requirements for welded pressure vessels up to 3" thick.

THE HEDGES-WALSH-WEIDNER CO.
CHATTANOOGA, TENN.
200 Madison Ave., NEW YORK, N. Y.
733 Mayo Bldg., TULSA, OKLA.

THEY KEEP A-RUNNING



*10 Horse Power Century Squirrel Cage Induction 3 Phase Motor*

# For Pumps and Compressors

The ability to withstand the effects of moisture and dampness is one of the features of Century Polyphase Motors which makes them "Keep a-Running"... The windings are thoroughly insulated and are then saturated with insulating varnish. This preserves the insulation and protects the windings and assures the continuous operation necessary in pump, compressor and similar installations where damp surroundings are present.

Century polyphase motors are built in standard sizes from ¼ to 250 H. P.

Century MOTORS

*40 U. S. and Canadian Stock Points and More Than 75 Outside Thereof*

**CENTURY ELECTRIC COMPANY, 1806 Pine St., St. Louis, Mo.**

SINGLE PHASE, THREE PHASE AND DIRECT CURRENT MOTORS • MOTOR GENERATOR SETS • ROTARY CONVERTERS • FANS AND VENTILATORS

FOR MORE THAN 27 YEARS AT ST. LOUIS

# CAPACITY
## FOR MASSIVE CONSTRUCTION

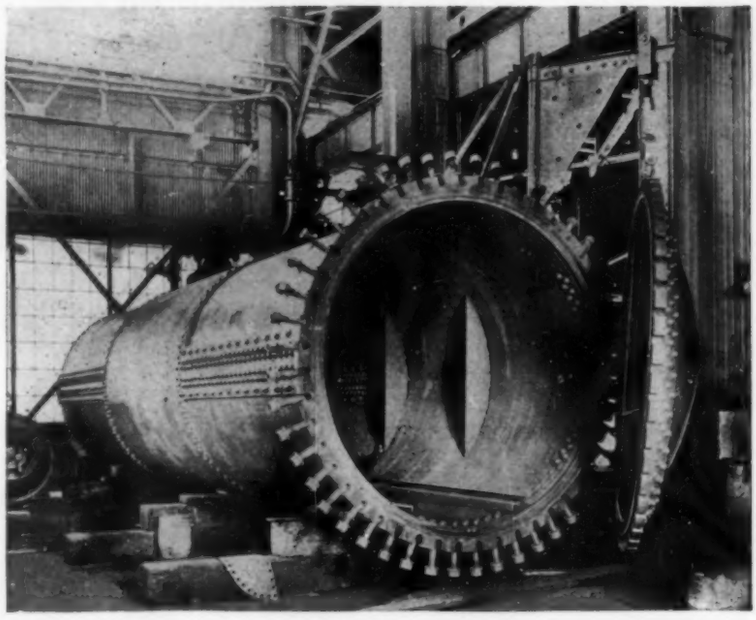
**WE ARE EQUIPPED** for massive construction and quantity production. Our facilities permit us to build in our shops at one time numerous pieces of equipment of large proportions.

TOWERS
STILLS
CONDENSERS
HEAT EXCHANGERS
TANKS . . .

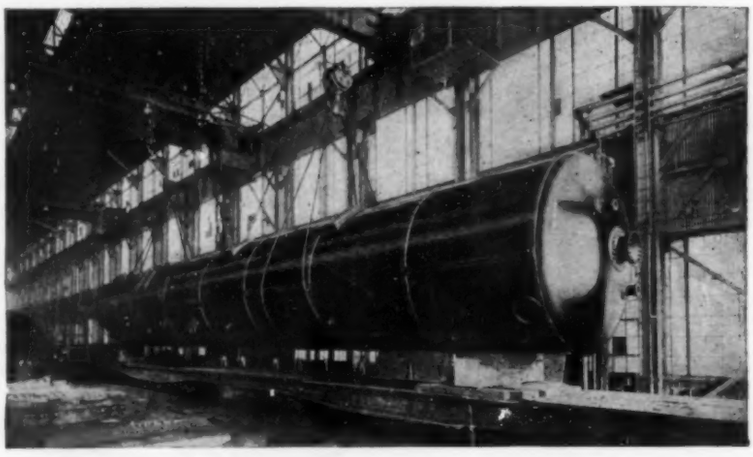
SPECIAL HEAVY BUILT TANKS . . .
RIVETED AND WELDED CONSTRUCTION

STILL BOTTOMS
ANGLE WORK
FABRICATED
PLATE WORK

Rail or Water Shipments
Estimates on Request



IMPREGNATOR SHELL



TOWER—13' 4" DIAMETER x 95' HIGH—WEIGHT 250,000 LBS.
HANDLED AND SHIPPED IN ONE PIECE

# SUN SHIPBUILDING & DRY DOCK CO., Chester, Pa.

# Buying a Sludge Pump?

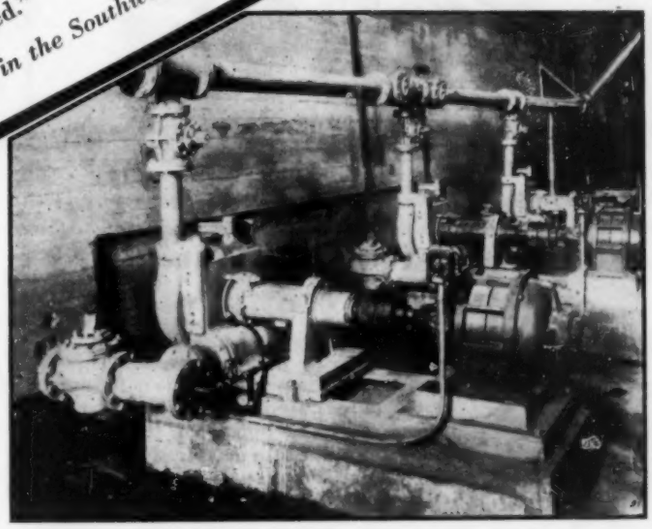
## Let This Letter Guide You!

"In regard to the absence of the stuffing box, we find this to be a great asset in operation. The way the pump is arranged, it facilitates the renewal of parts much more easily than any other pump we have used, and its continuance of performance is far ahead of anything we have used for the conveying of slurry.

"The performance of the Wilfley Pump is practically continuous and needs very little attention, and the repair cost is also very small in comparison with the former type of pump used."

*(From a prominent cement plant in the Southwest.)*

CENTRIFUGAL WILFLEY PUMPS



THE PUMP about which this cement company writes so favorably, is the pump "without a stuffing box"—the Wilfley Pump. This feature makes it ideal for handling sludges, particularly the hot caustic sludges and oils so frequently found in process work.

No stuffing box means less maintenance; easy and quick take-up of clearances—no falling off in capacity; extra-heavy parts—long life; no gland water—no dilution; quick change of pumping parts—little time lost.

These are the features that make the Wilfley Pump ideal for handling sludges. Wilfleys in your plant will help lower operating costs.

A. R. WILFLEY & SONS, Inc.
P. O. Box 2330 Denver, Colo., U. S. A.

**WILFLEY Centrifugal SAND PUMP**
PATENTED

*Seamless Steel Welding Fittings—*

45° and 90° Elbows
Tees
Reducing Tees
Reducing Nipples
Bull Plugs
Welding Neck Flanges

*Complete Specifications in Bulletin 31-1*

**TAYLOR FORGE**

TAYLOR FORGE & PIPE WORKS, Chicago
Box 485, Chicago — 50 Church St., New York

**GENCO TANKS**

**Wood Tanks**
Round, Rectangular, Oval and Special Shapes for Chemicals, pickling, plating, etc.

**Built of**
Cypress, fir, cedar, redwood, pine, maple, etc. Lined, unlined or coated as specified.
*Ample Stocks of High Grade Lumber Always on Hand*

**Steel Tanks**
Round, Rectangular and Special Shapes.
Monel Metal, Iron, Copper or Special Alloys. Lined, unlined or coated as specified.
*Full Gauge Materials Guaranteed.*

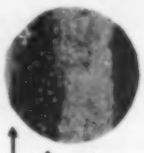
**Agitators and Agitator Drives**

Best of Materials and Construction
Complete Line All Styles and Sizes
Prompt Shipments Attractive Prices

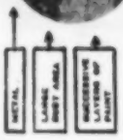
*Your inquiry will bring immediate reply.*

*The* **GENERAL TANK CORPORATION**
**30 Church St., New York, N.Y.**

**To prevent corrosion you've got to protect the *underlying surface***



This is an enlarged cross-section photograph of a chip removed with the fingers from the outside of a marine job. It is a graphic demonstration of the corrosion that often takes place unseen, underneath coatings of paint.




QUIGLEY TRIPLE-A AAA PROTECTIVE COATINGS

*penetrate* through surface pores and rust, and protect the *underlying metal* from the corrosive actions of water, acids, and alkalies. TRIPLE-A Protective Coatings are technical products developed and offered for the specific job of corrosion prevention in Industry—to meet conditions where paint has proved unsatisfactory. In exhaustive tests, as well as in thousands of installations in industrial plants of every description, TRIPLE-A Coatings have given very unusual service.

If you have a corrosion problem, it will pay you to investigate the possibilities of TRIPLE-A. A well informed Quigley representative is available to consult with you—and our laboratory stands ready to make any reasonable tests without cost or obligation to you.

Detailed description and cost saving applications are given in Booklet C-10 Write for booklet and test samples.

Use TRIPLE-A No. 10 Black to protect structural steelwork, tanks, condenser coils, boiler fronts and breechings, stacks, etc. Use TRIPLE-A colors to protect and decorate floors and walls, tank cars, and all exposed metal, galvanized or plated surfaces, concrete, brick, stone, wood and other materials. Also—for identifying pipelines in accordance with A.S.M.E. recommendations.

**QUIGLEY COMPANY, Inc.**
*Industrial Maintenance Products*
56 West 45th St. New York, N.Y.

Distributors with Stocks and Service in Every Industrial Center

Cole Pressure Creosoting Cylinder

**STEEL and ALLOY STEEL PLATE FABRICATION**
***exactly to specifications***

TANKS *and* VATS made from monel, Lukens nickel clad steel, or other metals.

Boilers—HRT
Agitator Tanks
Bubble Towers
Jacketed Kettles
Welded Steel Pipe
Creosoting Cylinders
Gas Scrubbers

**R. D. COLE MANUFACTURING CO.**
Established 1854
NEWNAN, GA. — New York Office, 5 Beekman St.

**COLE**

FABRICATORS OF STEEL AND ALLOY STEEL PLATE

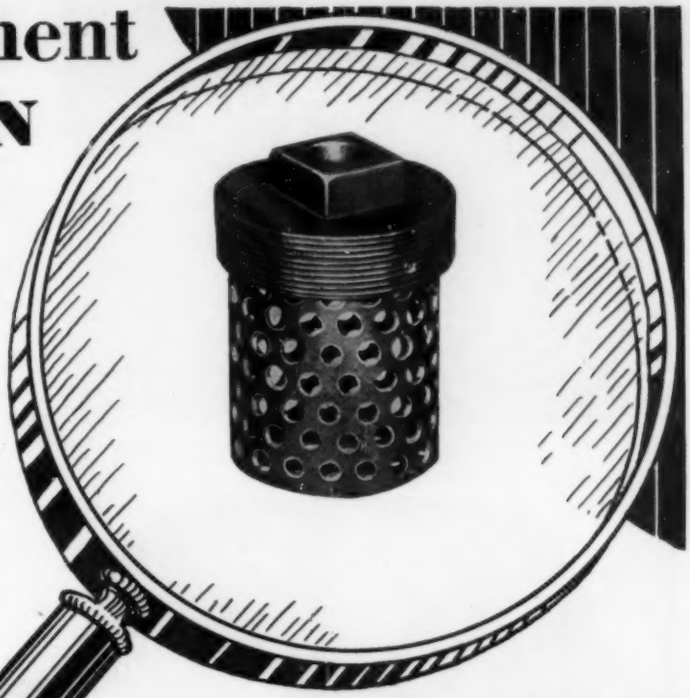
# Chemical Equipment to SPECIFICATION

## . . . *from a* STRAINER *to a* MIXER

**Built**

***Quickly***
***Correctly***
***Economically***

◆



# KOVEN

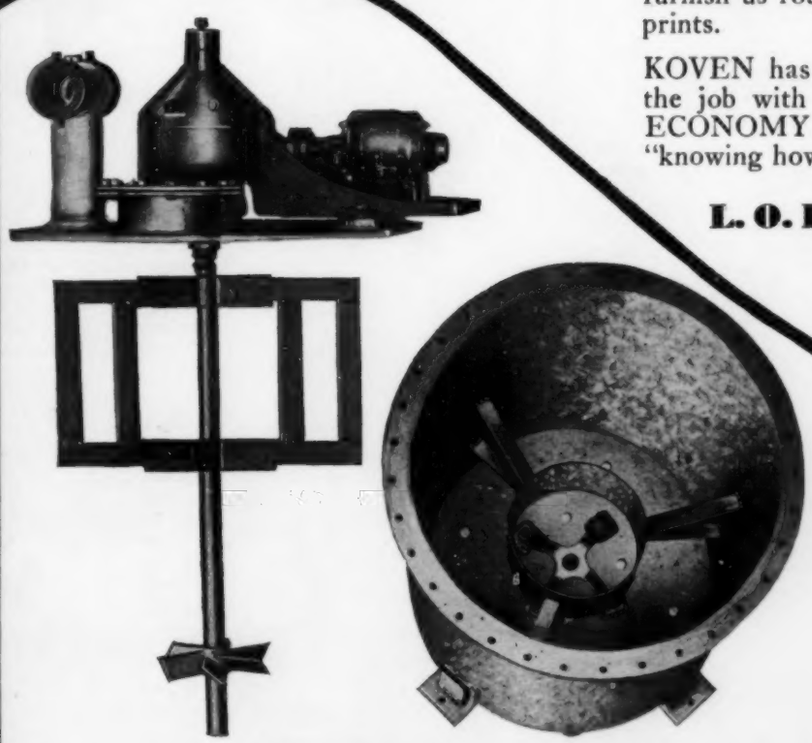
*specializes* in the fabrication of chemical equipment of any metal, alloy—or combination of metals.

It makes no difference how simple, or how intricate your requirements . . . whether you furnish us rough sketches, or complete blueprints.

KOVEN has *every* facility for turning out the job with the speed, thoroughness, and ECONOMY acquired thru fifty years of "knowing how".

**L. O. KOVEN & BROTHER**
**INCORPORATED**
**154 Ogden Avenue**
**JERSEY CITY, N. J.**

*Fabricators of Steel and Alloy Industrial Equipment*



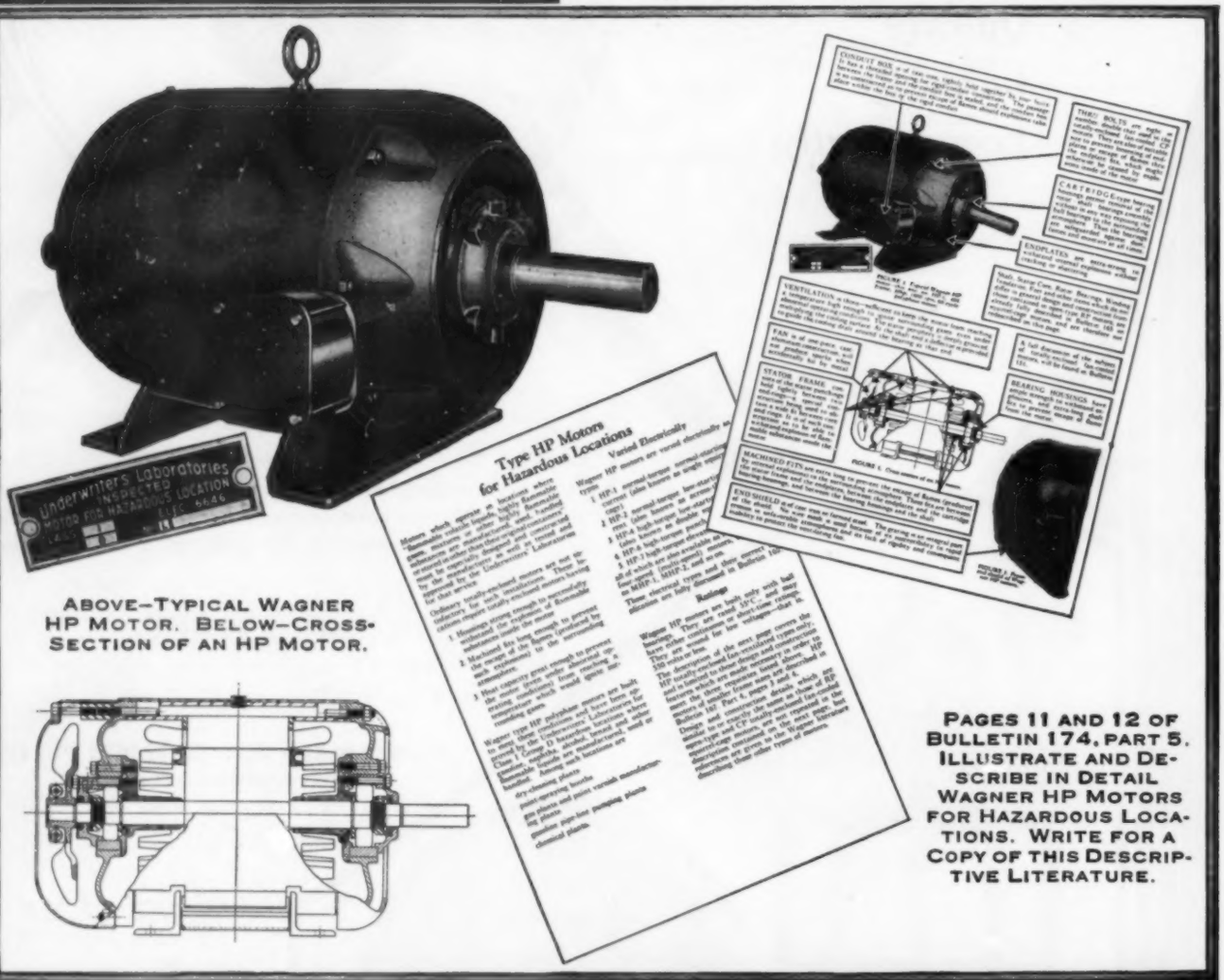
**Mixer with Agitator shown separately**

# HP Motors for Hazardous Locations

Motors which operate in locations where "flammable volatile liquids, highly flammable gases, mixtures or other highly flammable substances are manufactured, used, handled or stored in other than their original containers" must be especially designed and constructed by the manufacturer as well as tested and approved by the Underwriters' Laboratories, for that service. » » » Ordinary totally-enclosed motors are not satisfactory for such installations. These locations require totally-enclosed motors having

1. Housings strong enough to successfully withstand the explosion of flammable substances inside the motor.
2. Machined fits long enough to prevent the escape of the flames (produced by such explosions) to the surrounding atmosphere.
3. Heat capacity great enough to prevent the motor (even under abnormal operating conditions) from reaching a temperature which would ignite surrounding gases.

Wagner type HP motors are built to meet these conditions and have been approved by the Underwriters' Laboratories for Class I Group D hazardous locations where gasoline, naphtha, alcohol, benzol and other flammable liquids are manufactured, used or handled. Hence, they are ideally suited for the process industry—which has already recognized the advantages of totally-enclosed motors. » » »




ABOVE—TYPICAL WAGNER HP MOTOR. BELOW—CROSS-SECTION OF AN HP MOTOR.



PAGES 11 AND 12 OF BULLETIN 174, PART 5. ILLUSTRATE AND DESCRIBE IN DETAIL WAGNER HP MOTORS FOR HAZARDOUS LOCATIONS. WRITE FOR A COPY OF THIS DESCRIPTIVE LITERATURE.

WAGNER ELECTRIC CORPORATION
6400 Plymouth Ave., St. Louis, Mo.

Please send copy of Pages 11 and 12 of Bulletin 174, Part 5, which describe Type HP motors for hazardous locations.

Name and Position .....

Company .....

Address .....

L-431-2XB

# Wagner
## Electric Corporation

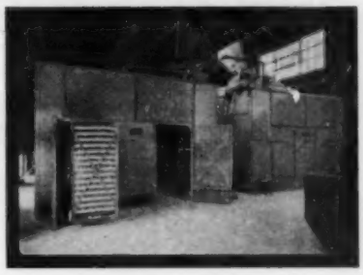
6400 Plymouth Ave., St. Louis, U. S. A.

**Motors Transformers Fans**
**Lockheed Hydraulic Brakes**

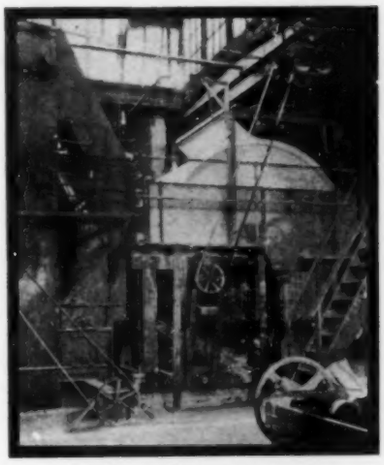
# SOMETHING TO DRY?

Proctor Dryers come in a variety of types and sizes . . . from small tray types to vast continuous systems.

## LET US SHOW YOU HOW TO DRY IT!



Truck System Dryer



Continuous Filter and Dryer

PROCTOR engineers have modernized drying methods with resulting great improvement and saving for many industries. They have acquired a wealth of drying experience . . . and of this you are invited to make full use when any question of how best to dry something presents itself. Often the answer to this question can be arrived at quickly in the Proctor laboratories . . . send samples of material for test and receive recommendations of suitable and economical equipment. Or it may take the thorough-searching Proctor field service to solve your problem . . . invite Proctor engineers into your plant to study your needs. Many firms regularly use Proctor research service.

**PROCTOR & SCHWARTZ • INC • PHILADELPHIA**

## Chrome Iron Special Equipment for Process Work

When you require tanks, cooler condensers, neutralizing tubs, agitators, absorption columns, acid coolers, gas coolers, pipe bends or similar equipment that must be produced to rigid specifications from corrosion-resisting metals, send your specifications to Edge Moor.

Over 60 years' experience in metal fabrication. Strategically located for convenient shipment by rail or water.

EDGE MOOR IRON COMPANY, Edge Moor, Delaware

# SPEED CONTROL IS COST CONTROL

**ACCURATE, FULL-RANGE SPEED CONTROL**

—provided by the REEVES Variable Speed Transmission for all types of industrial machines—

**STOPS THESE COSTLY PROFIT LEAKS:**

Inability to change the speed of a machine to match varying sizes or types of products, variances in materials, or variations in temperature and other influencing factors

$

Excessive percentage of wasted or damaged materials in production, caused by inaccurate machine speeds

$

Inability to balance and control flow of production (production slowed by one or more lagging machines)

$

Inability to provide for variances in the number and skill of operators

$

Expense of machine operator where automatic speed regulation would release him for other work

$

Machines in progressive operations not properly synchronized

**NOW READY FOR YOU—**

**• THIS NEW BOOK ON EFFICIENT SPEED CONTROL**

The new REEVES catalog—just off the press—is a highly valuable reference book for industrial executives, production managers, engineers, machine designers and plant maintenance men. It explains the increasing need and application of variable speed control, with specific examples in many industries. Fully describes the extensive line of REEVES Transmissions, including new designs, new controls, new refinements. Also convenient charts, tables, efficiency data and other essential facts. Send coupon today for your copy.

# REEVES

## Variable Speed Transmission

**• MORE THAN 50,000 NOW IN SERVICE •**

REEVES PULLEY CO., COLUMBUS, INDIANA

Please send me free copy of your new Catalog C-90.

Name.....Company.....

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**MARION Dolly Trucks**

# For ugly loads

**The MARION DOLLY TRUCK handles the awkward, bulky, heavy, hard-to-get-hold-of loads—cases, barrels, rolls, bundles, drums, carboys. It cradles the load, carries it swiftly, in perfect balance. Low skids permit loading from either side or either end. Built in seven sizes—high wheel and low wheel types—flat top and cradle top styles.**

**Cut your handling costs—utilize out of the way storage space—by using the strong, agile, smooth-running Marion Dolly. Write for circular.**

MARION MALLEABLE IRON WORKS

922 Miller Ave. Marion, Indiana

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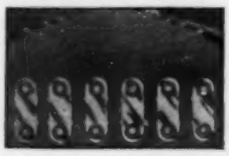
# Tight Butt Joints

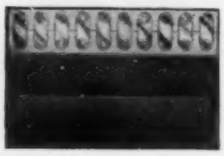
COMPRESSION PRINCIPLE

FAMED FOR DURABILITY

**CONVEYORS**



**ELEVATORS**



THE recessed plates embed in the belt and compress it instead of pulling against the bolt holes. This provides great surplus strength. It equalizes the pull throughout the plies. Keeps belt ends intact avoiding trouble. FLEXCO HD Belt Fasteners are in extensive use throughout many industries, giving long reliable service wherever tight butt joints are desired. Made in steel and in monel metal. Sold by jobbers and belting houses in 5 sizes. Recommendations supplied gladly.

FLEXIBLE STEEL LACING COMPANY

4636 Lexington Street Chicago, Illinois

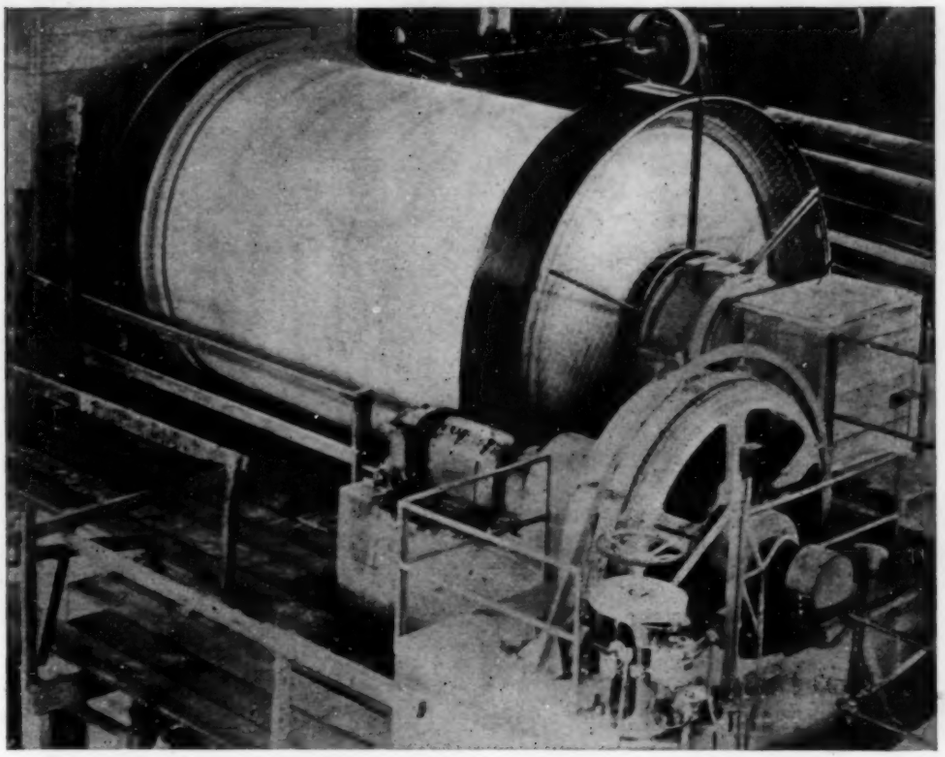
*In England at 135 Finsbury Pavement, London, E. C. 2*

**FLEXCO**

**HD**

**Belt Fasteners**

Tapered Roller
TIMKEN BEARING
EQUIPPED



# Another tough job that Timkens licked!

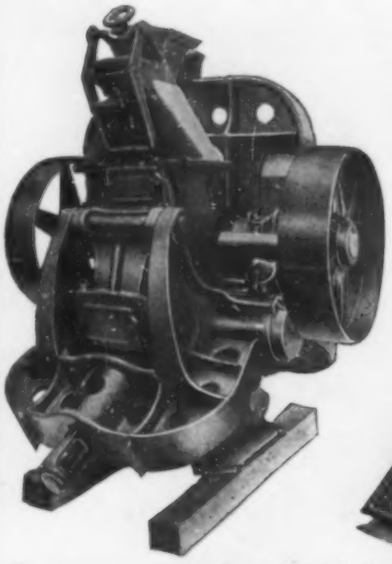
The pinion shaft of this Vulcan ball mill at the Morenci plant of the Phelps-Dodge Corporation is mounted on Timken Bearings. The builders, Vulcan Iron Works, Wilkes-Barre, Pa., installed Timkens to reduce the power demand and to carry the terrific radial-thrust loads developed by the drum and motor torque.

Three of these mills were built at the same time. All have given complete satisfaction over extended periods of service. It pays to specify Timken Bearing Equipped.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

**TIMKEN** *Tapered Roller* **BEARINGS**

## Maxecon Mill

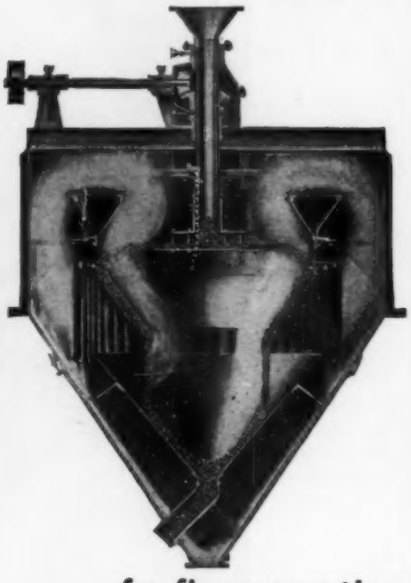


for economical pulverizing

## Perfectecon Screen

for coarse screening

## American Filter Air Separator



for fine separating

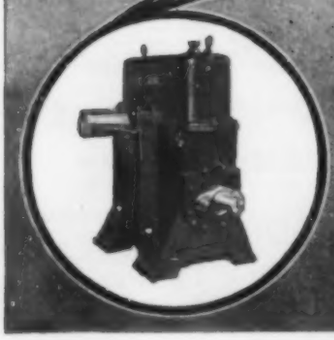
**KENT MILL COMPANY**

10 Rapelye Street Brooklyn, N.Y.

# De Laval Worm Gears

## *Keep Things on the Move*

THEY are self-contained and self-lubricated and operate continuously year in and year out, with no attention further than to see that the oil wells are filled. The 35 ratio gears in the photograph are transmitting 3 hp. each from 1200 r.p.m. motors to drive 150 ft. steel flight conveyors carrying empty barrels in an oil refinery.



**De Laval Steam Turbine Co., Trenton, N.J.**

# RESPONSIBILITY

## The complete drive is engineered by Allis-Chalmers . . . perfect performance is assured

THE simplicity of the Texrope Drive is deceiving . . . merely a set of V-belts running in grooved sheaves.

It is deceiving because you don't see the *engineering* that precedes the selection of the correct Texrope Drive.

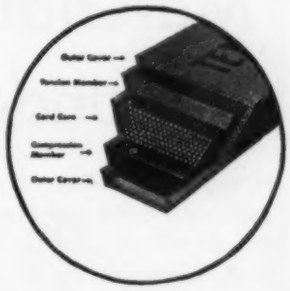
Belt speeds should not exceed a certain limit . . . it is not good practice to use sheaves smaller than the standards established by Allis-Chalmers . . . only certain belt sizes are practical for specific applications.

Every standard Texrope Drive is selected by an Allis-Chalmers engineer. Every special application is designed by specialists in Texrope Drives.

For these reasons, Texrope Drives are sold as complete units . . . And for these same reasons, Allis-Chalmers assumes absolute responsibility for the performance of the complete drive.

*Over 125,000 Texrope Drives are now in use . . . 25,000 users praise this product. Try Texrope on a drive that is causing trouble. Ask for Bulletin 1228.*

ALLIS-CHALMERS MANUFACTURING CO., (*Texrope Division*)
MILWAUKEE *Specialists in Power Machinery Since 1846* WISCONSIN



*— another B.F. Goodrich Product*

Texrope Belts are made by B.F. Goodrich for Allis-Chalmers. Complete stocks are carried in Allis-Chalmers warehouses all over the globe. When your belts finally need replacement the nearest Allis-Chalmers office will serve you promptly.

Copyright 1931 by Allis-Chalmers Mfg. Co.

ORIGINATED BY ALLIS-CHALMERS
**TEXROPE DRIVES**

THE DRIVES THAT REVOLUTIONIZED TRANSMISSION PRACTICE • • •

# Materials that retain insulating efficiency *under severe corrosive conditions*

In many applications in the process industries, electrical apparatus and motor operated appliances must resist the attacks of corrosive fluids or vapors. Since satisfactory performance of any electric device depends in a large measure upon its insulations, these parts must be corrosion-resisting.

Because they retain their insulating efficiency under severe corrosive conditions, Bakelite Materials have been chosen for countless difficult insulating problems. Bakelite Varnish protects and insulates armatures of motors and generators. Bakelite Molded parts guard switches, cable terminators and other electrical devices. Bakelite Laminated serves in such difficult applications as electro-plating tanks and large water ozonizers.

Where insulations must possess a combination of properties, including considerable dielectric and mechanical strength, resistance to moisture and most corrosive chemicals and to water, oils and greases some Bakelite Material will undoubtedly fill all of the qualifications. Write us for Booklet 7M, "Bakelite Molded", 7L, "Bakelite Laminated" or 7V, "Bakelite Varnish"—they contain valuable information on the properties of these materials.

BAKELITE CORPORATION, 247 Park Avenue, New York. CHICAGO OFFICE, 635 West Twenty-second Street

BAKELITE CORPORATION OF CANADA, LIMITED, 163 Dufferin Street, Toronto, Ontario

**BAKELITE**

REGISTERED U.S. PAT. OFF.

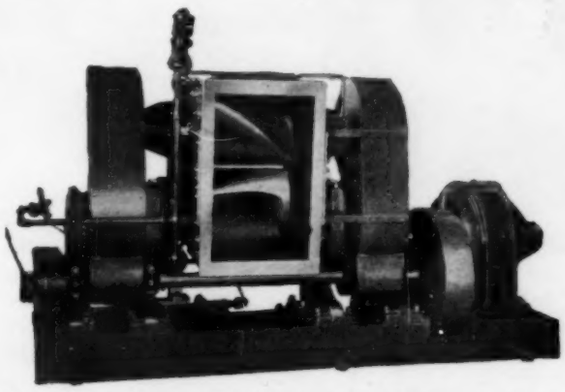
The registered trade marks shown above distinguish materials manufactured by Bakelite Corporation. Under the capital "B" is the numerical sign for infinity, or unlimited quantity. It symbolizes the infinite number of present and future uses of Bakelite Corporation's products.

THE MATERIAL OF A THOUSAND USES

## THAT MIXING PROBLEM!

*Why Worry About It?*

IN co-operation with our clients' engineers, we often build special machines not listed in our catalogs.



Size 15, type VI, Class BBCC Mixer and Kneader for extra heavy duty (trough viewed in discharging position).

TURN IT OVER TO US AND LET US DO YOUR WORRYING

If yours is an unusual problem—a pioneer job on a new product—for which none of the standard mixers on the market appear suitable, all the more reason to consult with us.

We solicit your confidence and your patronage on our record of having filled successfully the needs of some one hundred industries for mixing, kneading, blending, masticating, pulping and shredding, dissolving, diluting, and dispersing machinery.

Put it up to Baker Perkins—designers and builders of machines *exactly fitted to the job.*

BAKER PERKINS COMPANY, INC.
*Werner & Pfleiderer Division*
Main Office and Plant: Saginaw, Michigan
Sales Offices in
New York, Buffalo, Chicago, San Francisco

# MODERN ELECTRICAL SEPARATION

**JIG - TABLE - FLOTATION**

Concentrates

↓

ELECTRICAL SEPARATION

The difference in CONDUCTIVITY
A basic principle of operation

Non-conductors of Electricity | Conductors of Electricity

**MAGNETIC OR NON-MAGNETIC**

Concentrates or Tailings

↓

ELECTRICAL SEPARATION

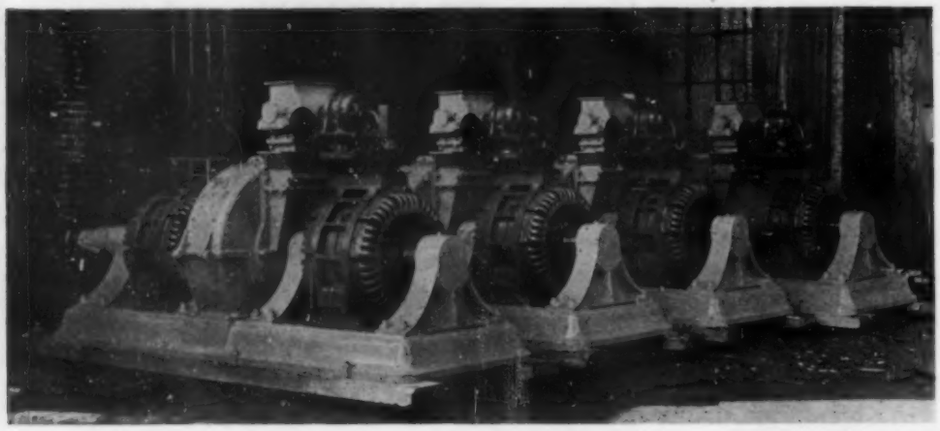
Non-conductors of Electricity | Conductors of Electricity

*No Royalties*
*Low Maintenance Cost*
*Low Operating Cost*

Our Research Laboratory is at your disposal and can give you specific information about your Problems.

TECHNICAL SALES CORPORATION
Graybar Building, 420 Lexington Avenue, New York
and
CARTHAGE MACHINE COMPANY
Carthage, N. Y.

# HEAVY DUTY MONARCH ATTRITION MILLS



**for Quantity Grinding at Minimized Cost**

**Attrition grinding is recognized as the most economical method and is applicable to many products which are being ground by more costly methods. The heavy duty Monarch Attrition Mill is working on hard jobs like grinding rubber, wood flour, pulp wood, smokeless powder and other products and doing it in a most efficient and economical way. We invite you to tell us what you have to grind, or better submit a sample and we will tell you frankly what you may expect a Monarch to do working on it.**

## SPROUT, WALDRON & CO., INC., MUNCY, PA.

Manufacturers

GRINDERS — CRUSHERS — SIFTERS — PACKERS — DUST COLLECTORS — ELEVATORS, ETC.

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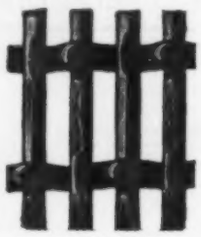
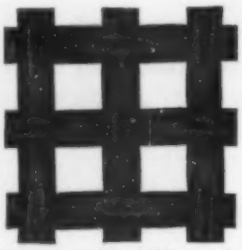
## *For the sake of your product*



Rolled Slot

If screening and sifting enters into the preparation of your product then you will want Cleveland Wire Cloth. It's the sure way to be sure about the separation and grading—no matter what the product. There is a weave, size and material for every job—backed by a knowledge of process application insuring better results over longer periods of time.



¼-in. opening 3/16-in. wire

*Prices and samples on request.*

**Cleveland Screen is manufactured in Steel, Brass, Copper, Monel, Nickel, Aluminum, Phosphor Bronze and Stainless Steel—a material for every material condition—a weave for every requirement.**

**The Cleveland Wire Cloth and Mfg. Co.**
3574 E. 78th St., Cleveland, Ohio

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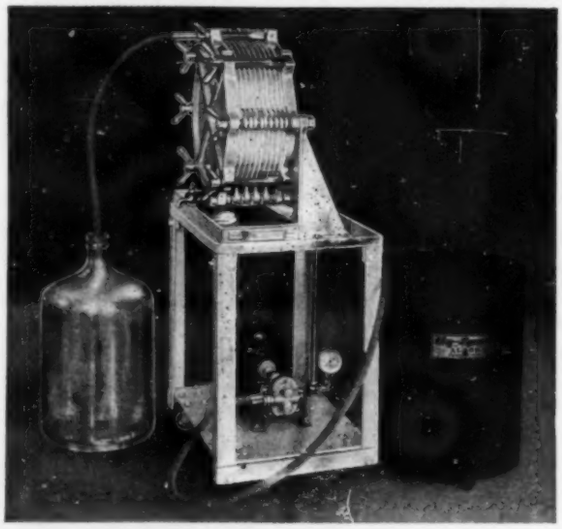
## NEW *Hy-Speed* ASBESTOS DISC FILTERS



**A crystal-clear brilliancy never before obtained, is given any liquid product by these revolutionary new filters. Send a sample of your own product for proof.**

"Hy-Speed" Asbestos Filter Discs can be supplied to fit any disc filter. Send for sample discs, specifying exact diameter and type of liquid.

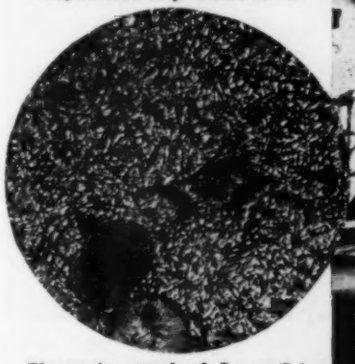
**ALSOP ENGINEERING CORP.**

Mixers, Filters, Pumps, Bottle Fillers, Glass-lined Tanks, Asbestos Filter Discs

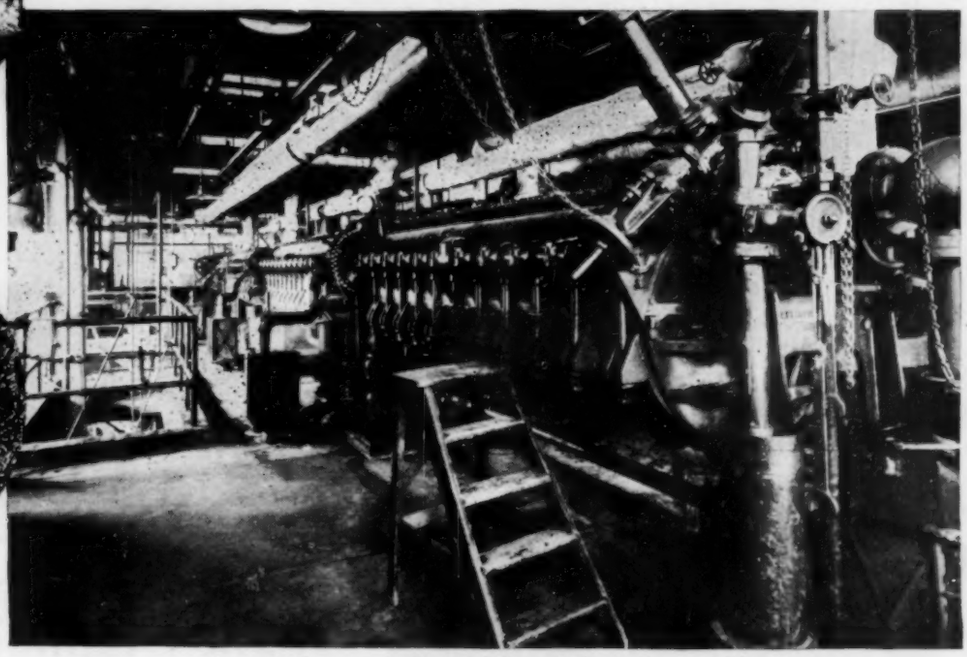
39 WEST 60th STREET NEW YORK CITY

# *thorough* Clarification . . .
# *sustained* High Rates of Flow
# . . . *low* Filtration Costs

Photomicrograph of closely woven filter cloth. The large holes between the fibres pass finely divided suspended matter.



Photomicrograph of Super-Cel Filter-Aid enlarged to the same diameter as above. The uniformly fine texture guarantees perfect filtration and dependable results.



*A row of filters at the National Sugar Refinery Company Plant, Long Island City, N. Y., where J-M Celite Filter-Aids are used.*

MICROSCOPIC impurities that frequently pass through filter cloth, resulting in cloudy filtrates, cannot pass through J-M Celite Filter-Aids. For these filter-aids form a screen 100 times finer than the closest woven filter cloth—finer than the smallest suspended precipitates.

J-M Celite Filter-Aids are made from the highest-quality diatomaceous silica obtainable. Three grades—Hyflo Super-Cel, Standard Super-Cel and Filter-Cel—are provided to give maximum rates of flow consistent with complete clarification of liquids, depending on the characteristics of the suspended matter.

In cane sugar filtration work, Hyflo Super-Cel affords utmost economies—long sustained high rates of flow—perfect clarification—reduced filter-cloth wear. Its companion filter-aids complete the range of filtration requirements for the raw sugar house, white sugar plant and refinery.

Let us send you our booklet, "Celite Filter-Aids"—no obligations. Address Johns-Manville, 292 Madison Ave., New York.

**CELITE MINERAL FILLERS**

Absolutely uniform powders of amorphous silica with definite fineness specifications, varying upwards from 1 micron in particle size.

*Weight* 8-28 lbs. per cu.ft.

*Color* White, cream, pink.

*Characteristics*—Immense surface area and great bulk per unit of weight. Of uniform chemical composition. Inert to practically all chemicals except alkalies and strong acids. Highly absorptive.

*Uses*—In rubber, asphalt, and gum plastics to decrease weight and add strength, toughness and durability. In paints it is an ideal white inert or extender and flatting agent. In polishes as a mild abrasive. In lightweight, safe and fireproof concrete construction. As catalytic carriers, solvent absorbents, etc.

# Johns-Manville

# *Celite Filter-Aids*

# CONTROL YOUR DOLLARS

## *in Raw Materials*

## *PROCESS Shipments*

YOU want to know just how much raw material is received or sent into process.

AND how much raw material or semi-finished ingredients go to make up the finished product—Also to be sure your finished product is according to specifications and that no product is wasted because of varying percentages of ingredients.

LIKEWISE you want to know exactly how much material you ship in bulk and to be certain your bags, drums or barrels contain the exact amount stated—no more and no less.

All this is possible through the use of Richardson Automatic Weighing Equipment.

*Richardson CONVEYoWEIGH for continuously receiving, feeding, weighing, recording and delivering materials in bulk.*

RICHARDSON AUTOMATIC SCALES are designed to accurately weigh and record all kinds of materials and for all operating conditions—for hot or cold materials; for solids and liquids; dry and moist ingredients; pulverized or lumpy.

Place your particular problem before us. Write for new Bulletin 9831 which illustrates and describes the Richardson CONVEYoWEIGH.

## Richardson Scale Company

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30 Church St., New York, N. Y.



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# CALDWELL Helicoid

*and Sectional Flight Screw Conveyor*

Caldwell Conveyors are the result of more than 50 years of experience in the art of spiral conveying. Caldwell originated the Helicoid type. Our line is complete—troughs, fittings, hangers, linings, couplings, box ends, etc. Stocked throughout the country for prompt shipment. Send for catalog.

## LINK-BELT COMPANY

**CALDWELL-MOORE PLANT**

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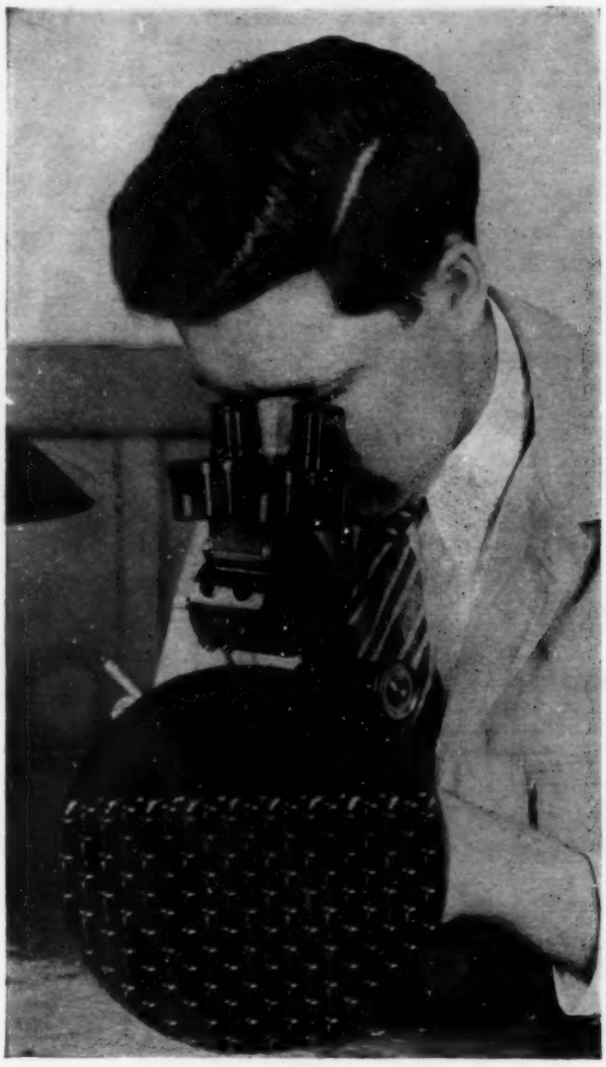
*Offices in Principal Cities* 4414

# Microscopic Checking of Wire Cloth Pays



With your naked eye you have never seen an edge on wire cloth like the magnified edge of SEALEDGED (Patented) shown in the circle at the left.

The Newark Wire Cloth Co. makes many weaves of cloth so fine that the details of construction cannot be appreciated without a microscope. Our 400 mesh cloth, which is the finest in the world, is so very fine that examination and checking without a microscope is utterly impossible.

We recommend microscopic checking because we know it *pays* to use only the highest quality cloths. The careful buyer will always measure the diameter of both warp and shute wires by means of a micrometer.

## Count the Mesh

When a purchaser orders a certain mesh he should, of course, get exactly what he orders. He is entitled to what he pays for and he is therefore entirely justified in carefully checking the cloth in every way—not only the sample but the *delivered* cloth. To be assured on this point the consumer will do well to check the mesh count in *both directions*—especially on fine cloth. The coarser cloths are comparatively easy to check, but we find that even they frequently get through unchecked and inferior quality products result.

Remember, please, that the Newark Wire Cloth Co. makes wire cloth and wire cloth products for ALL industries. All weaves. All meshes. All lengths. All widths. And of all malleable metals including Monel Metal, aluminum, brass, copper, bronze, phosphor bronze, nickel, steel, manganese steel, stainless steel, silver, gold, platinum, "Nichrome," tinned metals and special alloys.

## Newark Wire Cloth Company

**350-364 Verona Ave., Newark, N. J.**

***West Coast Representatives:*** **The Pacific Metals Co., Ltd., Los Angeles and San Francisco, Calif.**

**FILL IN, TEAR OFF, AND MAIL THIS COUPON**

**Newark**
**Wire Cloth Co.**
**350-364 Verona Ave.**
**Newark, N. J.**

Without obligating us in any way please send a copy of your Catalog No. 26. We are interested in the following:

- ☐ The "Newark" Cornerless Testing Sieve — U.S.S. — A.S.T.M. Standard;
- ☐ The finest wire cloth in the world — 400 mesh — 160,000 square openings per sq.in.;
- ☐ "Newark" Metallic Filter Cloth;
- ☐ Gasketed Metallic Filter Cloth;
- ☐ Double Crimped Heavy Steel Wire Screen;
- ☐ Centrifugal Cloths;
- ☐ Steel Wire Cloth;
- ☐ Bolting Cloths;
- ☐ Bran Duster Wire Cloth;
- ☐ Dutch Cloths;
- ☐ Tinned Milled Screen Cloth;
- ☐ Washer Wires;
- ☐ Brass, Copper and Bronze Cloth;
- ☐ Coal and Sand Screens;
- ☐ Market Grade Brass and Copper Wire Cloth;
- ☐ Extra Fine Phosphor Bronze Wire Cloth;
- ☐ English Picker Cloth;
- ☐ Foundry Riddles;
- ☐ Paint Screens;
- ☐ Removable Protected Bottom Strainers;
- ☐ Fruit Testing Sieves.

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## Experimental Mixer

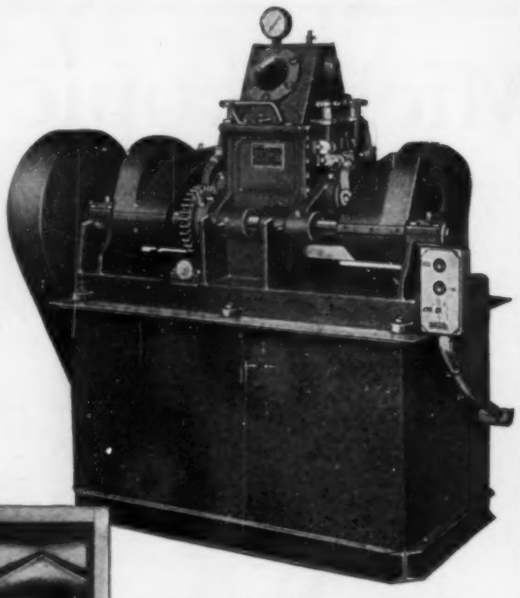
### for small production and laboratory

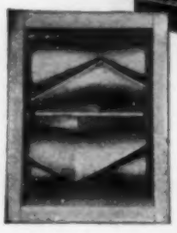
Simplifies experimental work in plasticizing, compounding, massing, heavy rubber doughs, and dispersions, by use of various types of agitators, each producing an entirely different action.

This mixer can be furnished with either plain or jacketed tank, with or without cover, or with vacuum type construction.

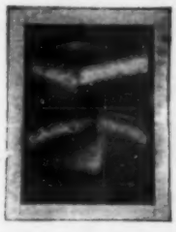
WRITE FOR FULL DETAIL.

*More than 15 different types of interchangeable and reversible agitators are available. The change from one type of agitator to another, or to reverse agitators, is accomplished easily and speedily.*





*Vacuum type MDA Mixer, class 8, Working capacity 2½ gallons.*



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SIZES 30 INCH TO 48 INCH
FLAT BOTTOM AND SELF-DISCHARGING
ELECTRIC AND BELT DRIVEN

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## S. S. HEPWORTH COMPANY

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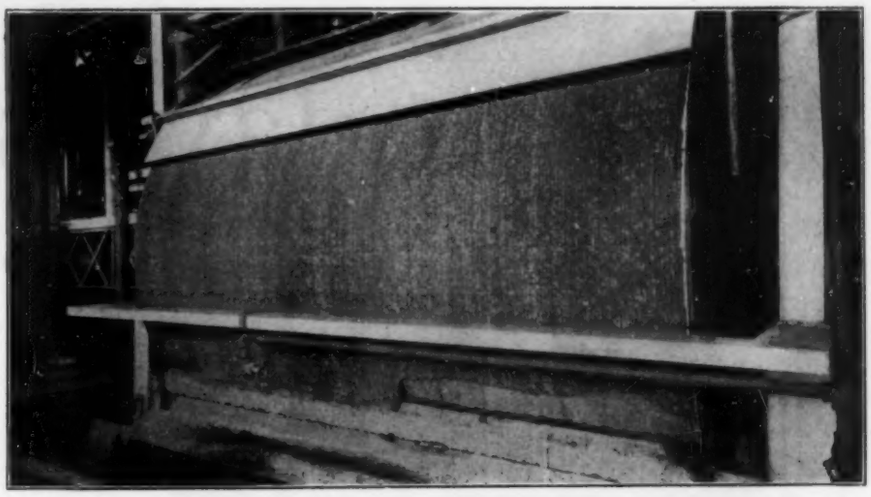
# Check Your Filtration Costs

## Modern OLIVER UNITED Units will help you

# SAVE



Filter cake being discharged from the Oliver-Campbell Filter at the sugar plant referred to below.

## HOW THESE PLANTS REDUCED PRODUCTION COSTS

A large producer of **chemical pigments** in the Southern States has just ordered more Oliver filters to get the best and cheapest washing of the pigment in process.

A **sugar** plant in Hawaii, where Oliver-Campbell filters were installed this year reports:—"Our sugar losses in filter cake have been reduced to a third of the previous press cake loss. In addition to this saving, operating labor is reduced to a single man for the Oliver-Campbell filter."

A New England **paper** manufacturer, investigating white water losses in his plant, found that existing methods of stock recovery could be replaced by Oliver United Save-Alls with an indicated saving of $75.00 per day. He bought the Oliver Uniteds.

A large **cement** company, operating mills in the Southwest, found that Oliver United slurry filters cut their fuel bill 30 per cent at one plant. As a result, an identical installation is going into another of the Company's plants.

These typical cases show that modern equipment may often be the answer to the question, "How can **we** cut production costs?" Let us check up on your filtration operations. Perhaps we can show you how you can SAVE.

**OLIVER UNITED FILTERS INC.**

SAN FRANCISCO
Federal Reserve Bank Bldg.

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★ *It can protect your product from substitution by jobbers or distributors—build up a name that your prospects will demand.*

This and the other uses of business paper advertising are explained in our book, "Industrial Advertising at Work." We will gladly send you a copy on request.



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Business men, industrialists and engineers—600,000 of them—regularly read the McGraw-Hill Publications. More than 3,000,000 use McGraw-Hill books and magazines in their business.

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Tell them your sales story through McGraw-Hill Publications. They'll listen. In a recent survey, 69% of those questioned declared that they not only read their business papers, but use them as buying guides! They pay in advance for their yearly subscriptions—to keep informed of new equipment, methods and services.

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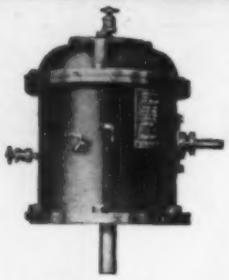
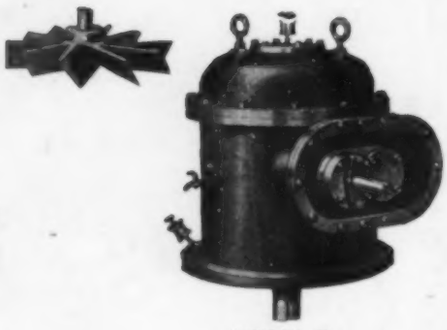
Factory and Industrial Management
Maintenance Engineering

The Business Week
System

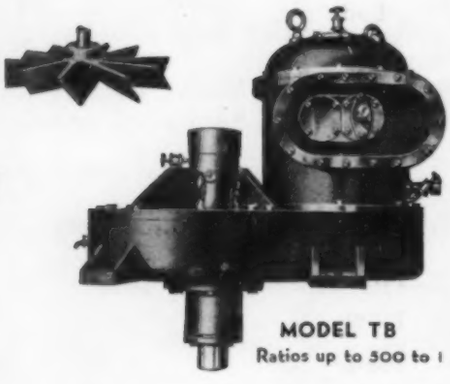
# AGITATION



MODEL WT
Ratios up to 68 to 1



MODEL T
Ratios up to 100 to 1



MODEL TB
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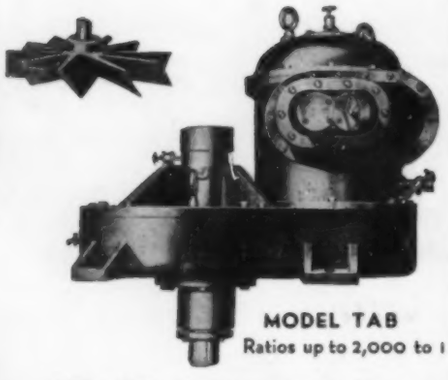

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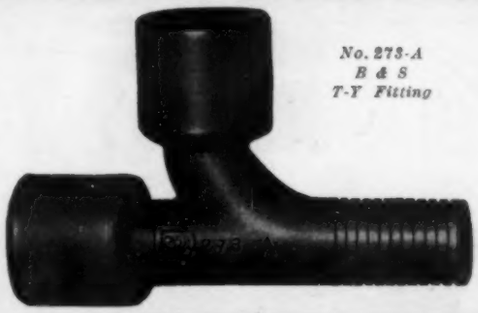

*No. 273-A*
*B & S*
*T-Y Fitting*

*For*

# Dependable, Permanent Installations—

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Chlorine in particular has no effect whatever upon the impervious body of Knight-Ware.

*No. 271*
*Straight Length*
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***Our 48-page catalog in color contains important information which ought to be in your files. Have you written for your copy?***

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*Sales Engineering Service from*
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ACID-PROOF CHEMICAL STONEWARE

# TERTIARY AMYL ALCOHOL

*(Technical)*

Sharples Tertiary Amyl Alcohol is a blend of Sharples Amyl Alcohols consisting of approximately 80% Dimethyl Ethyl Carbinol and 20% other Amyl Alcohols.

---

*This blend conforms to the following specifications:*

| | |
|---|---|
| Color | Water White |
| Specific Gravity at 20°C | 0.806—0.814 |
| Acidity | None |
| Water Content | None |
| Non-Volatile at 100°C | None |
| Clean non-residual odor | |
| Surface Tension | 26 dynes per square centimeter at 25°C |

SOLUBILITY:

| | |
|---|---|
| Alcohol 88% | Water 12% |
| Water 92% | Alcohol 8% |

DISTILLATION:

| | |
|---|---|
| Initial | Not below 89°C |
| Not over 5% | Below 98°C |
| Not less than 95% | Below 111°C |
| End Point | Not above 140°C |

---

*A number of suggested uses for Sharples Tertiary Amyl Alcohol are as follows:*

1. Dehydrating agent.
2. Fumigant.
3. Solvent for materials such as gums, resins, and some types of waxes.
4. Cleaning solvent for furs.
5. Anti-frothing agent.
6. Latent solvent in lacquers.
7. Production of tertiary amyl compounds.
8. For low surface tension effects in such places as lubricating oils.

---

This blend of Amyl Alcohols is available at a price that should make its use profitable in any formula where such a product is required.

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***Samples of this material for test purposes will be gladly furnished on request.***

SHARPLES TRADE MARK SOLVENTS

*The* **SHARPLES SOLVENTS** *Corp.*

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Year by year, the importance of Laboratory control is being recognized by progressive manufacturers. Uniformity and high quality of product can often be maintained only by direct control of manufacturing processes from the Laboratory properly equipped for this work.

**Continuous requisite accuracy in your Chemical determinations, quicker performance of your Laboratory operations and dependability in usage over a long period of time can be obtained only by using platinum. We can supply whatever you need in PLATINUM.**

**Pure Platinum and Platinum-Rhodium Laboratory Wares.**

**Crucibles — Dishes — Pans — Boats.**
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**Filter Cones — Crucible Tongs — Spatulas.**

**Perforated Sheet, Wire or Gauze Electrodes.**
All standard sizes and shapes.

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Pure or alloyed for any purpose. Any size.

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E. H. Sheldon and Company offer you a complete line of standard and custom-built laboratory furniture and fixtures to meet any need you may have.

*Write for our Industrial Catalog.*

**E. H. SHELDON & CO., MUSKEGON, MICH.**
***Laboratory Furniture and Fixtures***



# Look at these Savings

A glass manufacturer who previously had to tear down a vacuum pump once a week for cleaning, has not had to tear it down for two years since installing a Protectomotor Air Filter.

A gas company formerly had to clean valves every two months—now they have not required cleaning for nearly three years.

A porcelain plant eliminated tie-up in spraying work by placing a Protectomotor after separator in the air line.

A steel mill increased the output of pneumatic tool operators by using a Protectomotor to prevent clogging of tools.

A utility company prevented oil from decomposing rubber air hose extensions, thus more than tripling its life and stopping decomposed rubber getting to the air tools and interrupting the service.

A furniture and an automobile plant eliminated oil, water and foreign matter from paint when spraying, thereby making it unnecessary to do jobs over.

In every industry using air, Protectomotor Air Filters are effecting worth-while economies. More than 350,000 in use.

Our catalog tells how to cut costs. Write for a copy.

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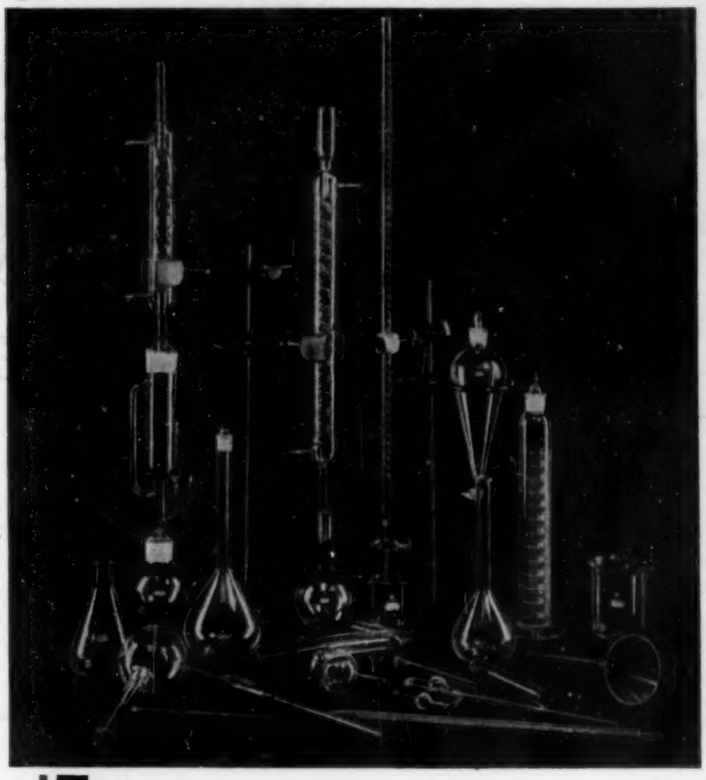
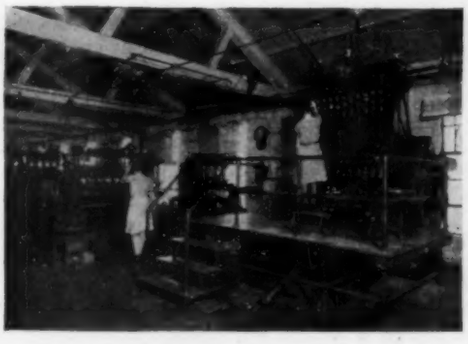
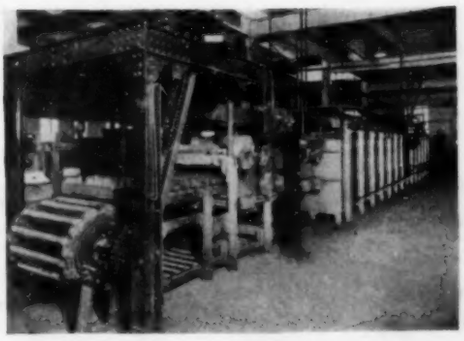
*Chemists everywhere recognize this mark as the symbol of unerring accuracy in technical glassware. It is a safeguard against inferior quality and assures the utmost in excellence of design and appearance, uniformity and resistance to breakage.*





*These multiple automatic machines place the lines and numerals on all Kimble Graduated Glassware, assuring maximum sharpness, legibility and uniformity.*



*This specially designed retempering furnace treats every piece of Kimble Glassware, eliminating strains in the glass and reducing possibility of breakage.*

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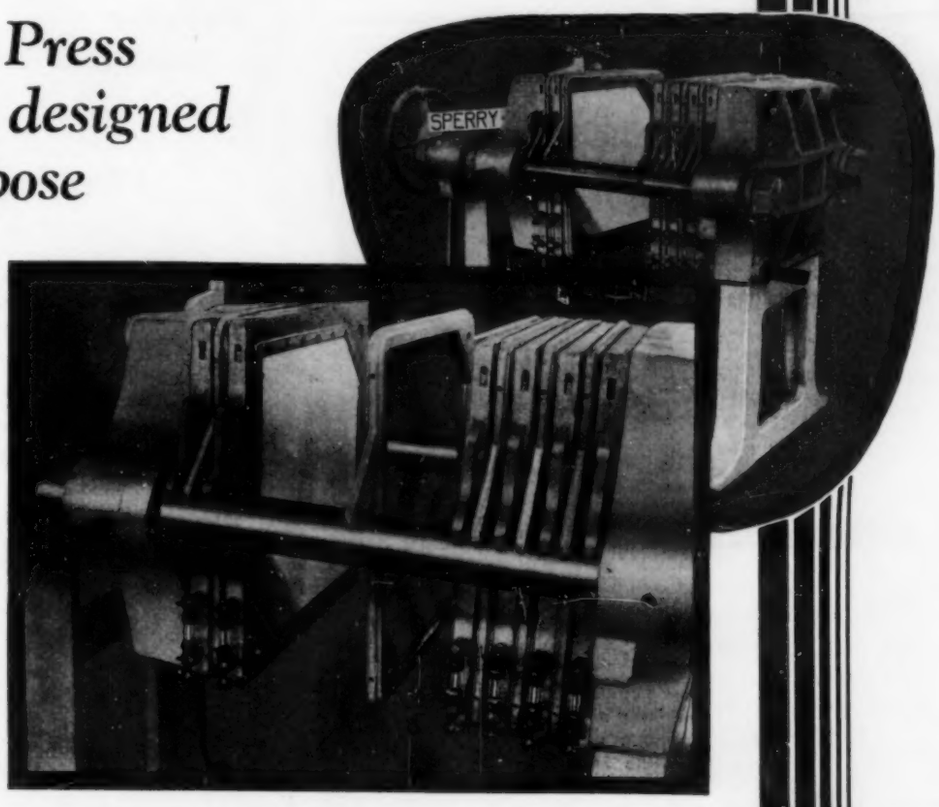


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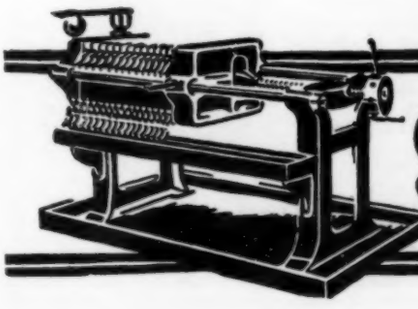

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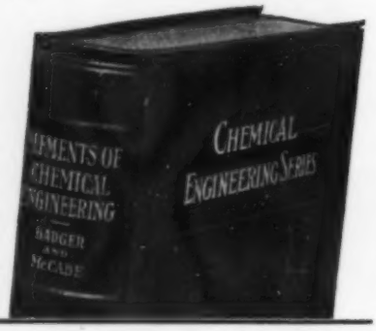


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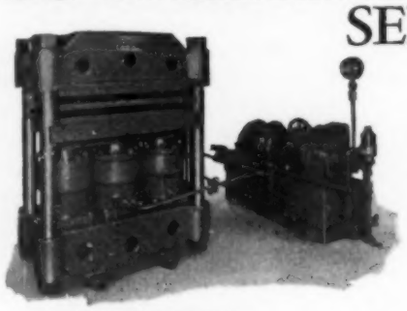

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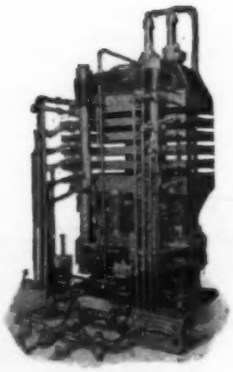
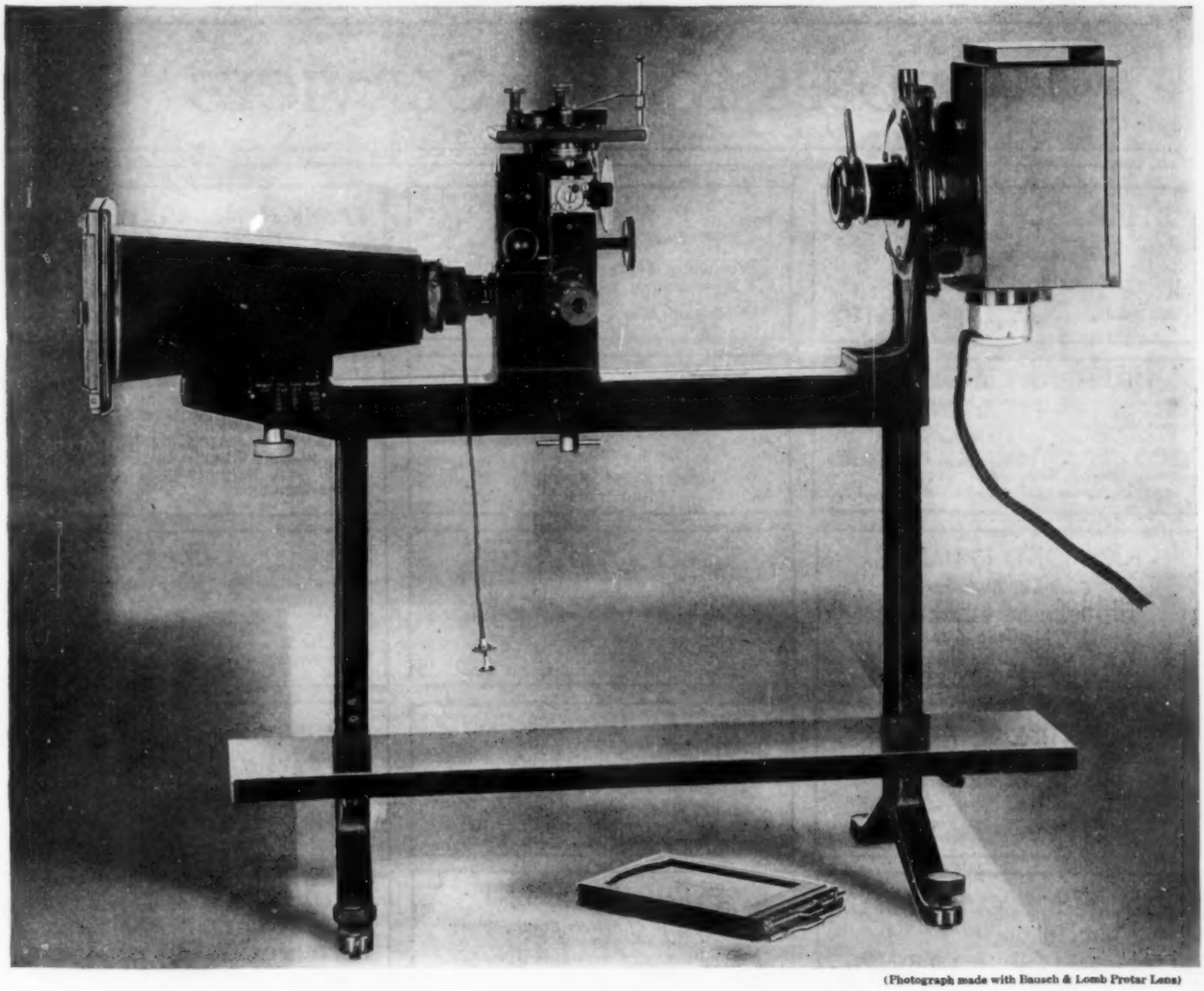


Laminated Glass Made on this Press



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12—Shriver, Johnson 12x12 in.

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**1—5x12-ft. Buffalo Vacuum Drum Dryer.**
**6—Dopp 650 gal. Jacketed Kettles.**
**6—Sweetland Filters, Nos. 12, 11, 9.**
**2—W. & P. 500 gal. Jacketed Mixers.**
**1—Buffalo J-20 Vacuum Shelf Dryer, 60x84-in. shelves.**
**1—6-ft. Buffalo Vacuum Crystallizer.**

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3—36-in. Shriver Filter Presses.
6—24-in. and 30-in. Shriver Filter Presses.
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1—Bartlett & Snow Rotary Hot Air Dryer, 5x30 ft.
5—Raymond Mills, Nos. 1, 0, 00, 000.
2—American Filters, 6-ft. and 8-ft. diameter.
1—6x22-ft. Harry Rotary Hot Air Dryer.
2—Devine 4x20-ft. and 5x25-ft. Rotary Vacuum Dryers.
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G-9

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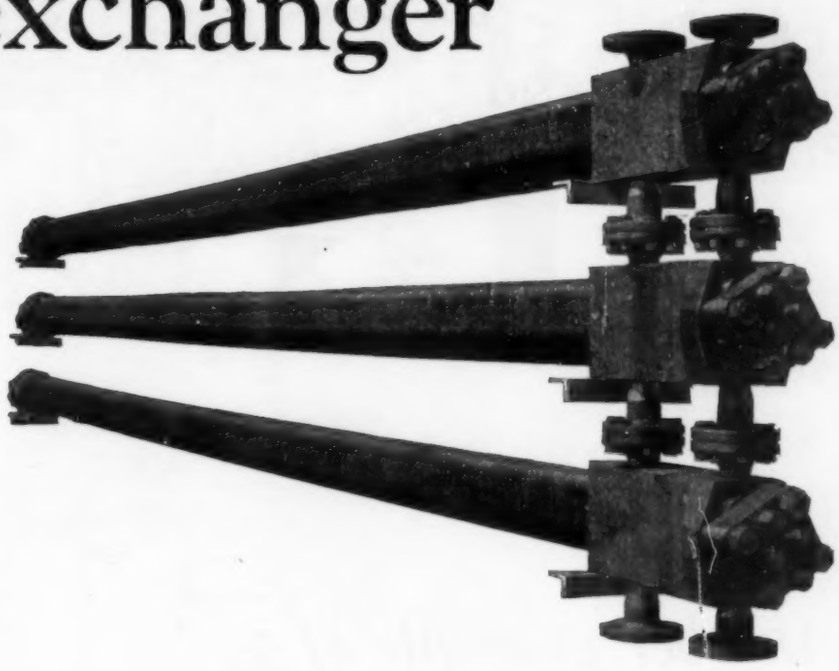

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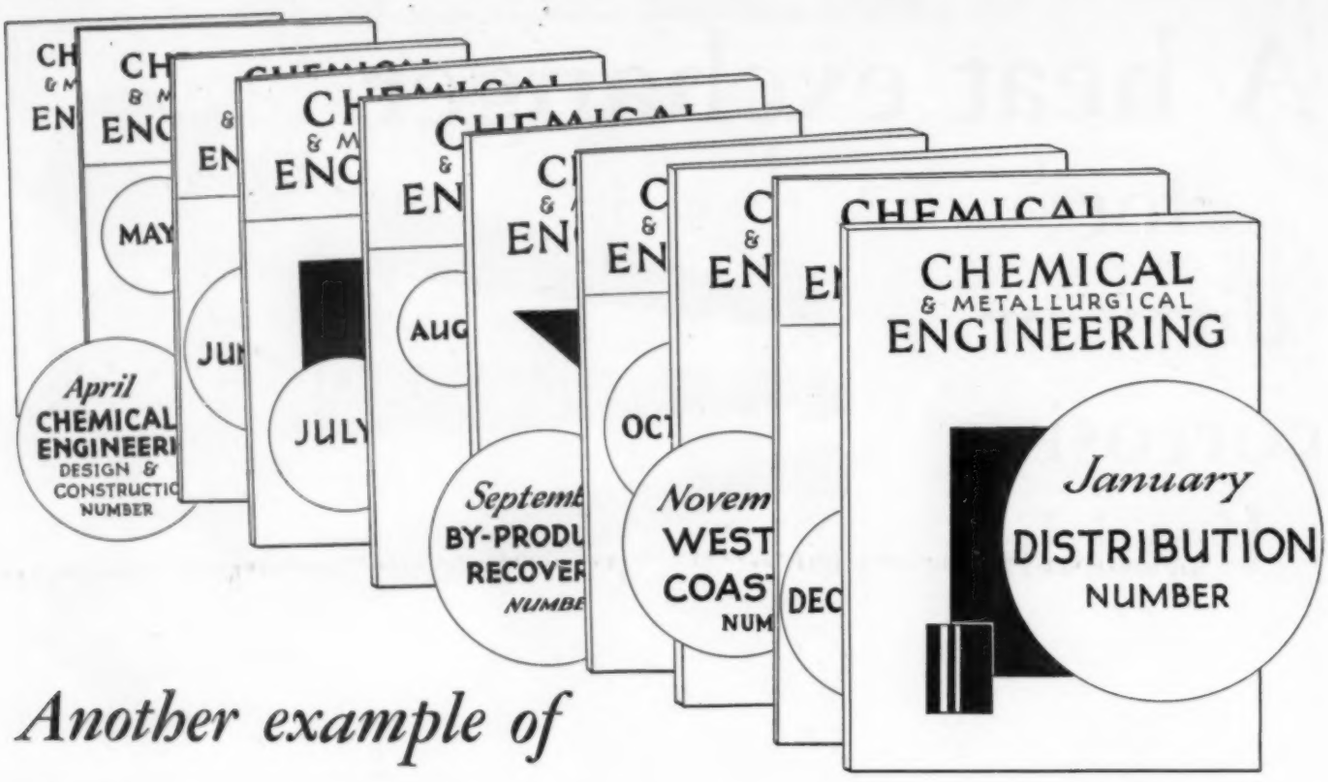


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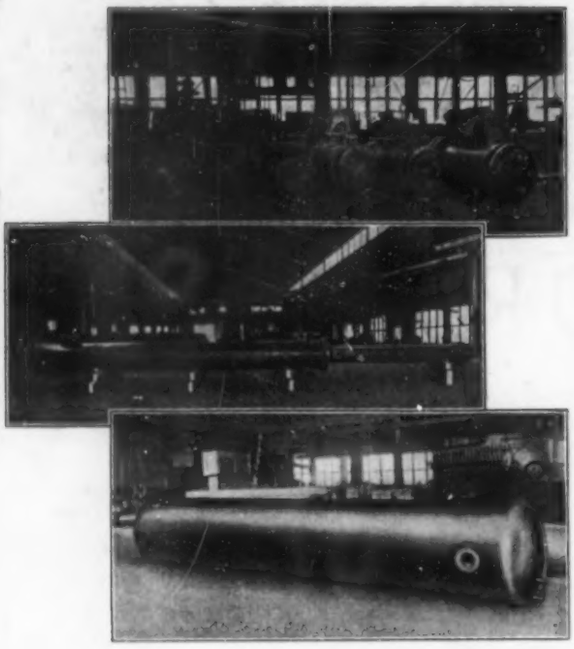

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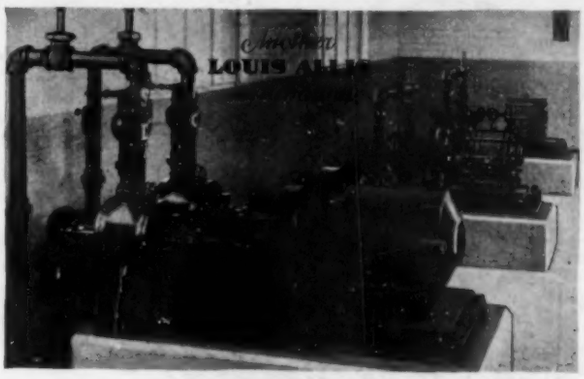
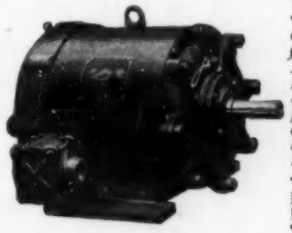


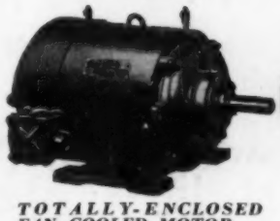
# L.A. "Explosion-Proof" Motors *eliminate fire walls* in Refinery Pump House

HERE is a new loading-rack pump house at one of the largest refineries in Oklahoma. These pumps handle *stove distillate, kerosene,* and *gasoline.* Yet there is no need here for the conventional fire wall, because the pumps are equipped with Louis Allis approved "Explosion-Proof" motors. Fire walls, although included in the original plans, were *eliminated* when L.A. "explosion-proof" motors were specified by the refinery engineer. ¶ This motor—extensively used in the manufacture of lacquer, film, gasoline, etc. — is only one of the complete line of Louis Allis "Custom-Built" motors *specially developed* for conditions in the chemical and process industries. To make your plant safer and more efficient, specify the correct type of Louis Allis motor for every application.

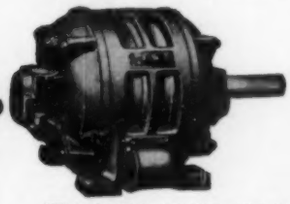


**Write for Bulletins on:** *"EXPLOSION-PROOF" FAN-COOLED MOTOR...Type E... for explosive atmospheres. Approved by Underwriters' Laboratories for Class I applications wherever petroleum products, alcohol, ethyl acetate, or equally hazardous liquids are made, used or handled.*

**WARNING:** DO NOT CONFUSE WITH NON-APPROVED, SO-CALLED "VAPOR-PROOF" MOTORS.



*TOTALLY-ENCLOSED FAN-COOLED MOTOR... Type J... for dusty, corrosive or moist atmospheres.*



*STANDARD "OPEN TYPE" MOTOR...for ordinary atmospheres.*

LOUIS ALLIS

# "Custom-Built" MOTORS

**THE LOUIS ALLIS CO.**
**Milwaukee, Wis.**

OFFICES . IN . PRINCIPAL . CITIES

# Are You ready to- "Give 'er the Gun"?

THE WISE PILOT sees to it that his ship is properly equipped, adequately fueled and expertly tuned-up, before he starts "zooming."

Flying weather is improving in the business world. Are you ready to "give 'er the gun"? An all-important preliminary for you is the installation of efficient, modern equipment for every process in your plant.

Make use of our 36 years' experience in designing and building equipment which tunes-up production in the process industries. Consult us on the equipment listed.

FJS

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Solvent Recovery Apparatus
Vacuum Shelf Dryers
Vacuum Stills
Atmospheric Drum Dryers
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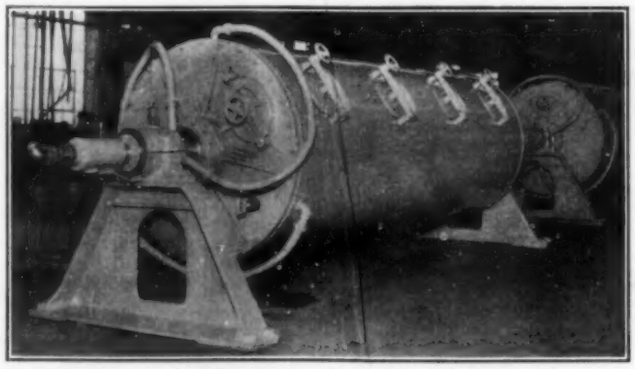
Extractors — Condensers
Crystallizers — Water Stills
Tablet Compressing Machines
Vacuum Fumigators
High Vacuum Pumps
Impregnators
Mixers
Special Process Equipment

**Send for Catalog No. 31**



STOKES Combination Equipment for soaking, drying and roasting under vacuum. Original order consisted of 4 units, each 3 ft. in diameter by 15 ft. long. User has since duplicated the order with the comment, "No suggestions for change; apparatus works perfectly." Such combining of processes saves in first cost, handling time and floor space. Result—profit margin increased.

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